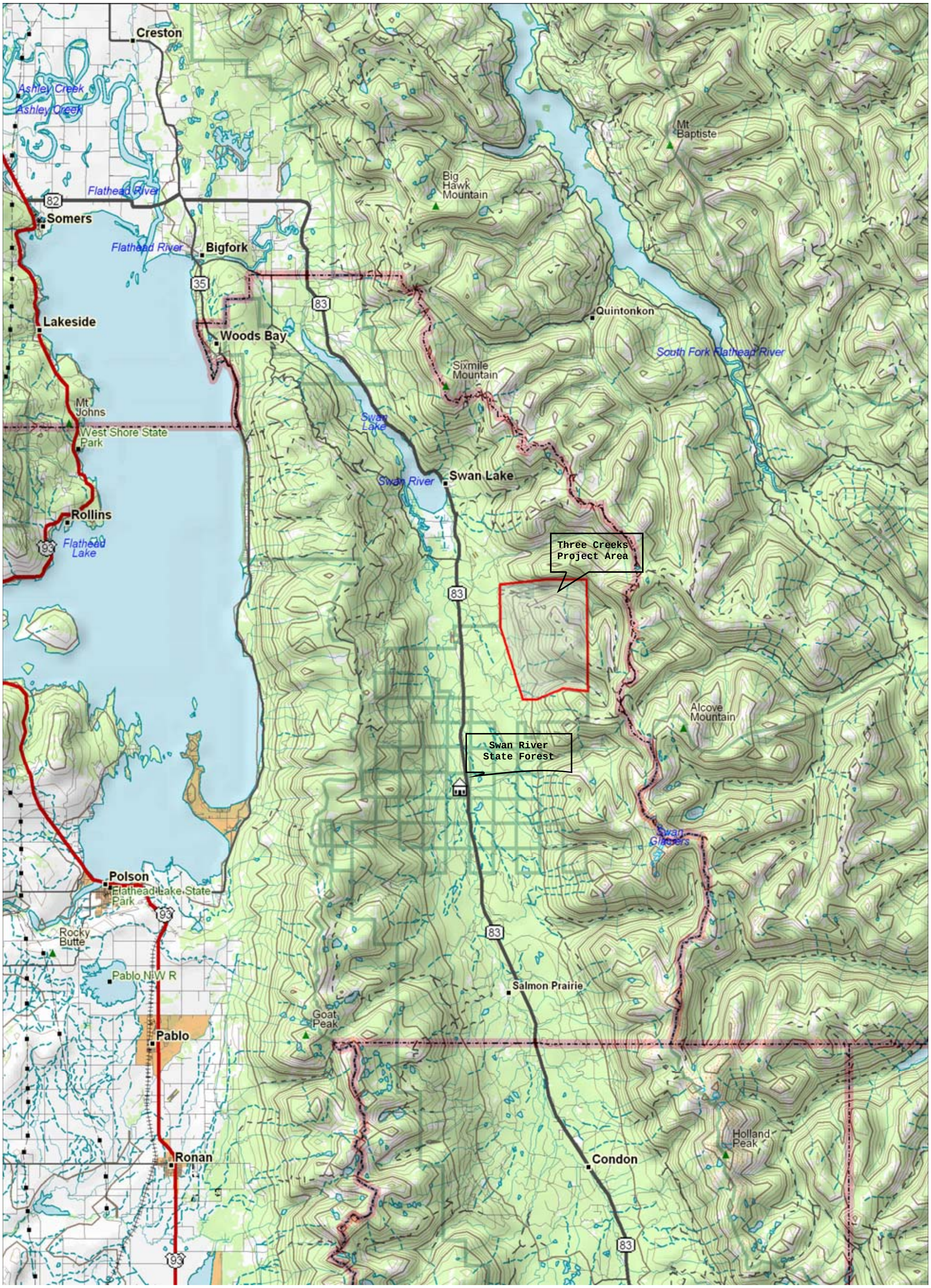
Three Creeks Timber Sale Project

Three Creeks Timber Sale Project

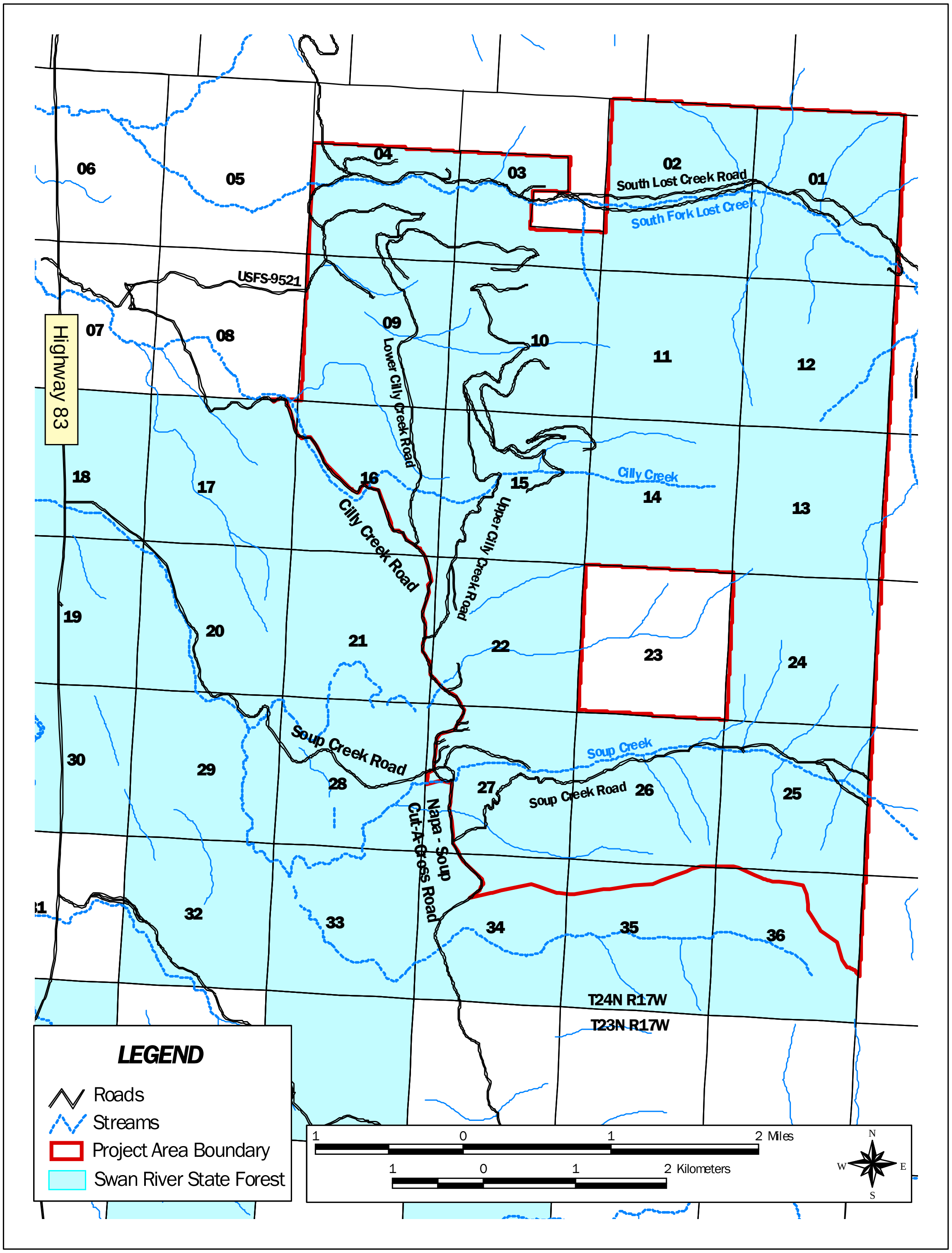
FINAL ENVIRONMENTAL IMPACT STATEMENT
RESOURCE APPENDICES

Department of Natural Resources and Conservation
Swan River State Forest
DECEMBER 2006

Three Creeks Timber Sale Project Area
Vicinity Map



THREE CREEKS TIMBER SALE PROJECT AREA MAP



APPENDIX A
LIST OF RELATED ENVIRONMENTAL REVIEWS

INTRODUCTION

In order to address direct, indirect, and cumulative effects on a landscape level, the analysis must incorporate past, present, and future actions within the analysis area. The following activities are located within the Three Creeks environmental analysis area for vegetation on Swan River State Forest. The environmental analysis areas for watershed, wildlife, soils, fisheries, etc., are smaller in size and encompass an area specific to those disciplines.

DNRC TIMBER SALE AND ROAD PROJECTS

State timber sales where environmental analyses have been completed and sale activities have begun or have been completed:

- Goat Squeezer Timber Sale Project EIS
- Napa Lookout Permit
- Cilly Bug Salvage Permit
- Rock Squeezer Salvage Permit
- Red Ridge Salvage Permit

State timber sale proposals with an environmental review in progress:

- The Fridge Salvage Permit (2006)
- Various thinning projects

The proposed White Porcupine Timber Sale Project is identified on the DNRC 3-Year Listing as the next potential project for Swan River State Forest. As yet, however, an initial proposal or proposed action has not been done. The potential project has not been scoped and, therefore, DNRC has not initiated a preimpact study on this proposal.

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT (SVGBCA)

Beginning in December 1994, DNRC has participated in the development and utilization of the SVGBCA with the United States Fish and Wildlife Service (USFWS), Flathead National Forest (FNF), and Plum Creek Timber Company. The SVGBCA seeks to cooperatively manage grizzly bear habitat in Swan Valley, where intermingled ownership patterns and differing land-management objectives complicate habitat management for a species as wide-ranging as the grizzly bear. USFWS evaluated the SVGBCA in an environmental assessment and found that implementing the Agreement’s management guidelines would not negatively impact grizzly bears (*USFWS 1995*).

The Three Creeks Timber Sale Project area is within the conservation area delineated in the SVGBCA and complies with its guidance.

OTHER ACTIVITIES

While the Forest Service has several ongoing or upcoming activities in Swan Valley, none within the analysis area for any resource. On Swan Lake Ranger District, The Sixmile Fuels Reduction and Prescribed Fire is the nearest action to the Three Creeks Timber Sale Project area (USFS 2006). However, this project does not fall within the defined cumulative effects analysis area for any resource.

APPENDIX B
STIPULATIONS AND SPECIFICATION

INTRODUCTION

The stipulations and specifications for the action alternatives were identified or designed to prevent or reduce the potential effects to the resources considered in this analysis. In part, stipulations and specifications are a direct result of issue identification, project mitigations, and resource concerns.

Stipulations and specifications that apply to harvesting or road-building operations will be contained within the Timber Sale Contract. As such, they are binding and enforceable. Project administrators will enforce stipulations and specifications relating to activities that may occur during or after the contract period, such as site preparation or hazard reduction.

The following stipulations and specifications will be incorporated to mitigate effects on the resources involved with the action alternatives considered in this proposal. Each section is organized by resource.

VEGETATION

➢ *Sensitive Plants*

Appropriate protection measures will prevent the disturbance of sensitive plant populations. Riparian areas near harvest units will be marked to protect SMZs and isolated wetlands. No harvesting is planned in wetlands or near springs on localized features. If sensitive plant populations are found, the appropriate habitat area will be excluded from the harvest units.

TABLE OF CONTENTS

Introduction B-1
Vegetation B-1
Watershed and Fisheries B-2
Wildlife B-4
Soils B-5
Air Quality B-6
Aesthetics B-6
Cultural Resources and Archaeology B-6
Roads B-6

➢ *Noxious Weed Management*

To further limit the possibility of spreading noxious weeds, the following weed-management mitigation measures will be implemented:

- All tracked and wheeled equipment will be cleaned of noxious weeds prior to beginning project operations. The contract administrator will inspect equipment periodically during project implementation.
- Surface blading on roads affected by the proposal may be required to remove weeds before the seed-set stage.
- Disturbed roadside sites will be promptly reseeded. Roads used and closed as part of this proposal will be reshaped and seeded.
- Herbicide application, as designated by the forest officer, may be used to control weeds along roads that access the timber sale area.

➢ *Herbicides*

To reduce risks to aquatic and terrestrial resources, the following will be required:

- All herbicides will be applied by licensed applicators in accordance with laws, rules, and regulations of the State of Montana and Lake County Weed District.

- All applications will adhere to BMPs and the herbicides' specific label guidelines.
- Herbicide applications will not be general, but site specific to areas along roads where noxious weeds grow. No-spray areas will be designated on the ground before applications begin.
- Herbicides will not be applied to areas where relief may contribute runoff directly into surface water.
- Herbicides will be applied on calm, rainless days to limit drift and the possibility of the herbicide moving off the road prisms.

WATERSHED AND FISHERIES

- Planned erosion-control measures and BMPs include:
  - installing grade breaks on roads,
  - installing water-diverting mechanisms on roads,
  - installing slash-filter windrows, and
  - grass seeding.
- All road-stream crossings will be monitored for sedimentation and the deterioration of the road prism.
- Equipment traffic will be allowed at road-stream crossings only where road prisms have an adequate load-bearing capacity.
- Culvert sizing for all road projects will be as recommended by the DNRC hydrologist for a 50-year-flood period.
- Stream crossings, where culvert or bridge removals and installations are planned, will have the following requirements, as needed, to meet the intent of water-quality permits and BMPs and protect water quality:
  - diversion channels will be constructed and lined with plastic to divert streamflow prior to any in-channel operations,
  - slash-filter windrows will be constructed on the base of fillslopes,
  - silt fences will be installed along the streambanks prior to and following excavation at crossing sites,
  - filter-fabric fences will be in place downstream prior to and during culvert installation, and
  - bridge work within stream areas will be limited to the period of July 15 through August 31.
- Brush will be removed from existing road prisms to allow effective maintenance. Improved road maintenance will reduce sediment delivery.
- The contractor will be responsible for the immediate cleanup of any spills (fuel, oil, dirt, etc.) that may affect water quality.
- Equipment that is leaking fluids will not be permitted to operate in stream-crossing construction sites.
- Included in the project proposal are the following pertinent recommendations of the *Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program Final Report, June 1991.* (The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154 through 162 of the *Final Report*.)

  1. BMPs are incorporated into the project design and operations.
  2. Riparian indicators would be considered in the harvest unit layout.
  3. Management standards of the SMZ Law (*75-5-301 MCA*) are used in conjunction with the recommendations of the study.

4. The BMP audit process will continue. This sale would likely be reviewed in an internal audit and may be randomly chosen as a Statewide audit site.

7. SMZs will be evaluated as a part of the audit process.

12. Watershed-level planning and analysis are completed. Logging plans of other agencies and private companies are used.

14. DNRC is cooperating with DFWP on the further study of fish habitat and populations for South Lost, Cilly, and Soup creeks.

15. DNRC would use the best available methods for logging and road building for this project.

16A. Existing roads are fully utilized for this proposal.

16B. DNRC utilizes BMPs, transportation planning, and logging system design to minimize new road construction.

17. DNRC requested inventory information from DFWP (versus contracts with DFWP to obtain species composition, spawning inventory, and spawning habitat quality). DNRC's mitigation plan for roads fits all recommendations for "impaired streams". Using "worst-case scenario" criteria provides for conservative operations in this proposal.

18. Provisions that address BMPs are in the Timber Sale Contract, which are rigidly enforced.

20. Long-term monitoring is planned for South Lost, Cilly, and Soup creeks, as well as other streams on Swan River State Forest.

29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC would continue to monitor fisheries in the future as funding allows.

- SMZs and RMZs will be defined along those streams that are within or adjacent to harvest units, and all applicable BMPs and the Rules for fisheries RMZ to fish-bearing streams will be followed.
- For the major streams (South Fork Lost, Cilly, Unnamed, and Soup creeks), a 300-foot buffer (150 feet on each side of the stream) will be maintained in areas where harvesting takes place on both sides of the stream or a closed canopy of, at least, pole-sized timber is on either side of the stream. Within the 300-foot buffer, a 25-foot no-harvest zone will be located immediately adjacent to the stream. Throughout the rest of the buffer, an average canopy closure of 40 percent will be maintained. The creation of some small openings up to 0.25 acre in size will be allowed as long as an average canopy closure of 40 percent can be achieved throughout.
- The SMZ law and Rules will be applied to all non-fish-bearing streams in the project area.
- *McNeil* core and substrate scores will be monitored in bull trout spawning reaches in South Fork Lost and Soup creeks.
- Fish-habitat monitoring, such as repeat R1/R4 surveying, will be done in South Fork Lost and Soup creeks.
- Riparian stand characteristics (quadratic mean diameter, trees per acre, basal area) will be monitored in proposed selective riparian harvest areas adjacent to South Fork Lost and Soup creeks.

- Angular canopy density (shade) will be monitored in South Fork Lost and Soup creeks adjacent to proposed selective riparian harvest areas.
- The frequency and volume of large woody debris will be monitored in South Fork Lost and Soup creeks.
- Stream temperature will be monitored in South Fork Lost, Cilly, and Soup creeks.

WILDLIFE

- *Grizzly Bears*
  - All action alternatives will comply with the SVGBCA.
  - Roads and landings will be seeded to revegetate with species less palatable to grizzly bears to minimize the potential for bear-human conflicts.
  - Garbage will be hauled or stored in a safe place so bears will not be attracted to the area.
  - No logging camps will be allowed within the sale area.
  - The Forest Officer will immediately suspend activities directly related to the project to prevent imminent confrontation or conflict between humans and grizzly bears, or other threatened or endangered species.
  - Contractors are prohibited from carrying firearms onto closed roads while working under contract.
  - Where regeneration harvests are proposed along open roads, vegetation screening will be retained within a 100-foot buffer.
  - Where regeneration harvests are proposed, no point in the harvest unit will exceed 600 feet to cover.
- Wolves

  A provision will be included in the Timber Sale Contract to protect wolf dens or rendezvous sites within the gross sale area discovered during implementation of the project.
- Big Game

  The purchaser will be authorized to enter the project area with motorized vehicles only for activities related to the performance of the Timber Sale Contract. Road use is restricted to nonmotorized transportation behind road closures for any other purpose. Motorized vehicle entry for purposes other than contract performance, such as hunting or transporting game animals, will be considered in trespass and prosecuted to the fullest extent of law (*ARM 45-6-203*).
- Wildlife Trees and Snag Retention and Recruitment
  - Wildlife trees of high quality, such as large broken-topped western larch, will be designated for retention and given special consideration during yarding operations to prevent loss.
  - Snag retention and recruitment—all cull snags that are safe to operate near and a minimum of 2 snags greater than 21 inches dbh are to be retained. If enough large snags are not present, the balance will be made up from the next largest size class available.
  - Retained snags that need to be felled for operational or safety reasons will be left on site.

SOILS

- *Compaction*
  - Logging equipment will not operate off forest roads unless:
    - soil moisture is less than 20 percent,
    - soil is frozen to a depth of 4 inches or a depth that will support machine operations (whichever is greater), or
    - soil is snow covered to a depth of 18 inches or a depth that will prevent compaction, rutting, or displacement (whichever is greater).
  - Existing skid trails and landings will be used when their design is consistent with prescribed treatments and current BMP guidelines are met.
  - The logging foreman and sale administrator will agree to a skidding plan prior to operating equipment.
  - To reduce the number of skid trails and the potential for erosion, designated skid trails will be required where moist soils or short steep pitches (less than 300 feet) will not allow access by other logging systems.
  - The density of skid trails in a harvest area will not exceed 20 percent of the total area in the cutting unit.
- Soil Displacement
  - Conventional ground-based skidding equipment will not be operated on slopes steeper than 40 percent. Soft-tracked yarders are suitable on slopes up to 55 percent. Cable yarding will be used on sustained steeper slopes.
  - Slash piling and scarification will be completed with a dozer where slopes are gentle enough to permit (less than 35 percent). Slash treatment and site preparation will be done with an excavator in areas where soils are wet or slopes are steeper (up to 55 percent). Broadcast burning may also be utilized.
- Erosion
  - Ground-skidding machinery will be equipped with a winchline to limit equipment operation on steeper slopes.
  - Roads used by the purchaser will be reshaped and the ditches redefined to reduce surface erosion prior to and following use.
  - Drain dips, open-topped culverts, and gravel will be installed on roads as needed to improve road drainage and reduce erosion and maintenance needs.
  - Some road sections will be repaired to upgrade the roads to design standards that will reduce the potential for erosion and maintenance needs.
  - Certified weed-free grass seed and fertilizer will be applied promptly to newly constructed road surfaces, cutslopes, and fillslopes. These applications will also be done on existing disturbed cutslopes, fillslopes, and landings immediately adjacent to open roads. These applications, which will stabilize soils and reduce or prevent the establishment of noxious weeds, would include:
    - seeding all road cuts and fills concurrent with construction,
    - applying “quick cover” seed mix within 1 day of work completion at culvert-installation sites, and
    - seeding all road surfaces and reseeding culvert installation sites when the final blading is completed for each specified road segment.

- Based on ground and weather conditions and as directed by the forest officer, water bars, logging-slash barriers, and, in some cases, temporary culverts will be installed on skid trails where erosion is anticipated. These erosion-control features would be periodically inspected and maintained throughout the Contract period or extensions thereof.

AIR QUALITY

- To prevent individual or cumulative effects and provide for burning during acceptable ventilation and dispersion conditions during burning operations, burning will be done in compliance with the Montana Idaho Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2.
- Excavator, landing, and roadwork debris will be piled clean to allow easy ignition during fall and spring when ventilation is good and surrounding fuels are wet. The Forest Officer may require that piles be covered to reduce dispersed (unentrained) smoke and allow the piles to ignite more easily, burn hotter, and extinguish more quickly.
- The number of piles to burn will be reduced by leaving large woody debris in the harvest units.
- Depending on the season of harvest and level of public traffic, dust abatement may be applied on some segments of the roads that will be used during hauling.

AESTHETICS

- Damaged submerchantable residual vegetation will be slashed.
- Landings will be limited in size and number and located away from main roads when possible.
- Disturbed sites directly adjacent to roads will be grass seeded.
- When possible, healthy trees not big enough to be harvested will be retained.

CULTURAL RESOURCES AND ARCHAEOLOGY

- A review of the project area was conducted by a DNRC archaeologist and local Native American tribal organizations.
- A contract clause provides for suspending operations if cultural resources are discovered and only resuming operations when directed by the Forest Officer.

ROADS

- Information about road-reconstruction activities and road use associated with road-construction activities will be relayed to the general public.
- Signs will be placed on restricted roads to prohibit public access while harvesting operations are in progress; these roads will be physically restricted during inactive periods (nights, weekends, holidays, shutdowns).
- BMPs will be incorporated into all planned road construction.

APPENDIX C
VEGETATION ANALYSIS

INTRODUCTION

This section describes current vegetative conditions on Swan River State Forest and addresses the potential effects of the alternatives as they relate to the following issues:

- movement toward or away from desired future conditions;
- management goals and activities that address insect and disease activities;
- current and future levels of forest fragmentation;
- impacts of harvesting on the amount and distribution of old growth, old-growth attributes, and the quality of old growth on Swan River State Forest;
- forest covertypes and age classes may be affected by timber harvesting and associated activities;
- timber harvesting and associated activities may reduce canopy cover;
- fire hazard may increase without timber harvesting;
- age and covertype patch sizes may be changed by timber harvesting;
- timber harvesting and associated activities may decrease sensitive plant populations; and
- timber-harvesting and road-building activities may increase noxious weeds in the project area.

ANALYSIS METHODS

The *Rules (http:// arm.sos.state.mt.us/ Title 36)* direct DNRC to take a landscape-level or coarse-filter approach to biodiversity. To promote biodiversity, an appropriate mix of stand structures and compositions on State land should be favored (*Montana DNRC 1996*). The coarse-filter approach utilizes landscape-analysis techniques to determine an appropriate mix of stand structures and compositions for Swan River State Forest based on ecological characteristics such as landtypes, climatic sections, habitat types, disturbance regimes, and other unique characteristics.

This vegetation analysis compares historic forest conditions, desired future conditions, and current stand conditions in terms of forest composition. Covertype representations and age-class distributions are specific characteristics shown in the landscape-level analysis to quantify project effects to forest vegetation and track movement toward or away from desired future conditions.

TABLE OF CONTENTS

Introduction C-1
Analysis Methods C-1
Analysis Area C-2
Past Management C-4
Stand Development C-4
Habitat Types C-4
Stand Vigor C-5
Elevation and Aspect C-5
Stand Structures C-6
Covertype and Age Classes C-7
Canopy Cover C-20
Fragmentation C-22
Insects and Diseases C-23
Fire Effects C-33
Old Growth C-37
Age and Covertype Patch Size C-54
Sensitive Plants C-59
Noxious Weeds C-60

Historic age-class and covertype conditions were quantified by *Losensky (1997)*. He used forest inventory data from the 1930s to estimate the proportion of historic age classes by forest covertype for Montana. This provided an estimate of age-class distribution and stand composition prior to Euro/American settlement and the effects of fire suppression, selective logging, cattle and sheep grazing, and the full impact of white pine blister rust. Current conditions and desired future conditions are defined using DNRC's site-specific SLI.

Forest fragmentation was analyzed by using aerial photographs of the project area and querying the SLI. Aerial photographs provided a visual of past harvesting and current stand appearances (stocking density, stand boundaries, etc.). Queries in the SLI provided information on contiguous areas of stands in the same age class, stocking levels, and stand densities. Alternative effects on the patch size of old-growth stands were also analyzed. Field visits helped to verify this information to establish increases/ decreases in a given patch size.

Insect and disease activities are recorded and mapped annually from aerial flight surveys. New occurrences and progression of existing pockets, along with approximate acreages and locations, are collected. Field surveys identify areas with insect and disease activities for timber-harvesting opportunities. Several successive years of flight-survey maps are available at the Swan River State Forest office.

The old-growth analysis relies on both DNRC's SLI and plot-level data collected for the project. The SLI was queried to select stands meeting the age, dbh, and large-tree criteria for old growth based on habitat-type groups (see *GLOSSARY* for DNRC's old-growth definition). Field surveys were employed to collect plot-level data in order to verify the old-growth status of selected stands and determine if additional stands meet the old-growth definition within the project area. Using the SLI and the additional plot-level data collected, attribute levels within old-growth stands are described and analyzed for preharvest and postharvest conditions

The analysis of stand development would be a qualitative discussion of the conditions of timber stands, including how various natural and man-caused disturbances and site factors have affected, and may continue to affect, timber-stand development. Project level and cumulative effects to forest vegetation are described and analyzed in terms of covertype representation, age-class distributions, old-growth amounts and attribute levels, stand structure, patch dynamics, forest fragmentation, and the role of insects and diseases.

ANALYSIS AREA

The analysis area was examined at 3 nested scales:

- the climatically-/ physiographically-defined "Upper Flathead Section" (M333C) of the larger, vegetation-defined "Northern Rocky Mountain Forest-Steppe-Coniferous Forest-Alpine Meadow Province" (Province M333) (*Bailey et al. 1994*);
- Swan River State Forest;
- and the Three Creeks Timber Sale Project area.

Climatic sections were described as broad areas of similar geomorphic processes, geologic origins, drainage networks, and landforms that influence precipitation patterns and temperature regimes (*Losensky 1997:19*). General location-based names for the various climatic sections were assigned to help understanding and communication. The Three Creeks

Timber Sale Project area in Swan River State Forest affects the timber base and sustainable yield derived through the forest-management program. Swan River State Forest is within Climatic Section M333C. Considering that each nested scale is important because activities within one can influence all and effects at one scale may be unapparent when presented at another scale.

- Section M333C: Historic conditions refer to those described by *Losensky (1997)*. In this analysis, the historic conditions for Section M333C relate to Swan River State Forest in terms of age-class distributions by forest covertypes.
- Swan River State Forest: Current and desired future conditions were analyzed at the scale of the entire Swan River State Forest, based on the Swan River State Forest SLI.
- Three Creeks Timber Sale Project Area: Within the project area, the effects to stands proposed for harvesting would be analyzed under each alternative.

Effects analyses are presented throughout the FEIS for both the entire Swan River State Forest and the project-level analysis area. Much of the analysis uses data from the SLI. The SLI quantifies forest-stand characteristics for all stands in Swan River State Forest and is incorporated into DNRC's Geographic Information System (GIS).

The SLI is updated annually to account for harvesting activities and periodically through reinventory. This process provides DNRC foresters with current data for use in analyses of proposed management activities. Since ongoing and future timber sales have not undergone postharvest inventory, probable effects of these sales are taken into consideration in order to address cumulative impacts in each analysis area. The SLI databases used for this analysis are dated August 8, 2001 (*sli poly 08082001 swn*), and May 13, 2005 (*swn sliwsnc20050513*). This data is available at the Swan River State Forest office.

One timber sale, Cilly Bug Salvage Timber Sale, was completed within the Three Creeks Timber Sale Project analysis area. The estimated effects of this project on the proportions of forest covertypes and age classes, along with effects of old-growth stands, would be considered along with the Goat Squeezer (I, II, III), Small Squeezer, Small Squeezer II, and South Woodward timber sales in a cumulative-effects analysis for Swan River State Forest.

The cumulative effects analysis area for vegetation is Swan River State Forest for desired future condition, covertypes, age classes, old-growth amounts, patch sizes, and other components of forest vegetation. Some old-growth attributes are analyzed at the scale of the project area to demonstrate cumulative effects, such as numbers of large live trees, snags, stand vigor, and other attributes in old-growth stands. Important to remember is the commitment DNRC made in the *SFLMP* and *ARM 36.11.407.39(a)* and *36.11.416(2)*: conditions made rare on the landscape through the activities of others will not be compensated for by the Department on the school trust lands we manage. That fundamental premise of DNRC's management philosophy also prevents the Department from utilizing, for example, the Bob Marshall/Scapegoat complex, to make up mitigations for activities on State land.

PAST MANAGEMENT

The project area has not had a large timber sale since the 1980s. Timber harvesting began in and adjacent to the project area during the 1960s. The first known harvesting, both inside and adjacent to the project area, took place in the early 1900s. Limited salvaging has taken place within the project area, but several permits have been completed in adjacent areas. The majority of the acres (54 percent) in the project area have never been harvested.

Most previously harvested stands have regenerated successfully, either naturally or by planting, and are dominated by western larch, Douglas-fir, and, in some areas, ponderosa pine. Many units have recently been precommercially thinned. Other past harvesting includes salvage, sanitation, and individual-selection treatments. Salvage harvesting, the most prominent type of harvesting, began in the early 1980s and continued through the late 1990s; salvage operations have not occurred in the project area for the last several years. Individual-tree-selection harvesting was conducted in the early 1970s.

STAND DEVELOPMENT

Natural processes of stand development and disturbance are influenced by environmental conditions and site characteristics, such as soils, stand covertype, forest health, elevation, and stand structure. The stand structures and species compositions can be greatly modified by natural disturbances, such as wildfire and blowdown. Without natural or human-caused disturbances, stands continue to move along the successional path, which leads to species conversion. In some instances, a previously open western larch/Douglas-fir stand begins developing an increasingly dense understory of grand fir and other shade-tolerant tree species. This process can eventually move the stand towards a mixed-conifer covertype. Many of the stands proposed for harvesting have this successional pattern occurring. Proposed treatments would reverse this process to earlier stages of succession dominated by seral species.

HABITAT TYPES

Site factors, such as soil type, aspect, elevation, growing season, and moisture availability, are combined to develop the classifications of habitat types, which are then used to describe successional development and timber productivity, among other things (*Pfister et al. 1977*). In the project area, 62 percent is categorized as belonging to the "warm and moist" habitat type. As these stands progress through successional stages, the mixed-conifer covertype would become more dominant. The lower elevation, moist-subalpine habitat type (*Fischer and Bradley, 1987*) occurs on 25 percent of the area. Also represented in the project area are 5 other habitat types, but in much lesser amounts. Information on habitat types for the remaining stands is available in the project file.

The stands proposed for harvesting are included in the warm and moist along with the lower elevation, moist subalpine fir habitat type groups. These groups typically have relatively high timber production, regenerate best with more intensive management treatments, and provide great opportunities for seral species. *TABLE C-1 - ACRES TREATED PER HARVEST PRESCRIPTION BY HABITAT-TYPE GROUP* shows the amount of acres being treated within these habitat type groups by harvest prescription.

TABLE C-1 - ACRES TREATED PER HARVEST PRESCRIPTION BY HABITAT-TYPE GROUP

ACTION ALTERNATIVE	HARVEST PRESCRIPTION	HABITAT TYPE GROUPS		
		WARM AND MOIST	MOIST, LOW ELEVATION SUBALPINE	*TOTALS*
B	Seedtree	134		134
	Seedtree reserve	543		543
	Shelterwood	593	61	654
	Commercial thin	486	67	553
C	Seedtree	98		98
	Seedtree reserve	480		480
	Shelterwood	675		675
	Commercial thin	531	67	598
D	Seedtree	113		113
	Seedtree reserve	540	133	673
	Shelterwood	314	309	623
	Commercial thin	439	121	560
E	Seedtree	135		135
	Seedtree reserve	441	133	574
	Shelterwood	461	143	604
	Commercial thin	580	103	683

STAND VIGOR

Stand vigor, a qualitative assessment of stand health in relation to growth potential, is affected by a variety of factors such as stand age, density, insects, diseases, and weather. Insects and diseases are currently very active within the project area, decreasing vigor, reducing growth, causing mortality, removing stands from the old-growth classification, and resulting in lost economic value. Elevated populations of Douglas-fir beetle, fir engraver, and mistletoe, as well as minor infestations/ infections from mountain pine beetles, white pine blister rust, and various heart rots exist throughout the project area. Indian paint fungus is common in grand fir. The majority of the tree species show effects from insect infestations and/or disease infections, which cause value to be lost. Also, tree crowns appear sparse, yellowing, and/or fading in many stands, reflecting poor health and slow growth.

The SLI identifies stand vigor for each stand on Swan River State Forest in 1 of 4 categories. The 4 categories for vigor classification are full, good, fair, and poor. The majority of the stands in the project area fall in the good to average category, which is also reflective of the stands proposed for harvesting (*TABLE C-2 - STAND-VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE*).

TABLE C-2 - STAND-VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE

VIGOR	ACTION ALTERNATIVE			
	B	C	D	E
Good	51	53	59	58
Fair	38	39	30	41
Poor	11	8	11	1

ELEVATION AND ASPECT

Elevation and aspect interact to influence the tree and shrub species potentially present in a stand, as well as to influence successional pathways and percent of ground cover. The project area ranges in elevation from 3,400 to 6,600 feet. A large portion of the project area has a south-to-west-to-northwest aspect, resulting in sites that are relatively warmer and drier than those on north- or east-facing aspects. Warmer, drier stands typically develop overstories of western larch and/or Douglas-fir, or, occasionally, ponderosa pine on the drier sites. Stands with north-facing slopes, either entirely or in part, often have higher moisture availability and are located where species such as western red cedar and true firs are often found.

The majority (61 percent) of the old-growth stands proposed for harvesting are on south to west aspects in the mid-elevation zone, between 3,500 and 4,500 feet. Treatments for these particular stands vary depending on the aspect and elevation and the influence these would have on regeneration. The south to west aspect sites receive much direct sunlight and tend to have drier soils. Due to these sites being drier and warmer, shelterwood and commercial-thin treatments are proposed for these aspects. These treatments would also provide a greater opportunity for regeneration survival.

STAND STRUCTURE

Stand structure indicates a characteristic of stand development and how the stand would continue to develop. The disturbance regime or most recent disturbance event can also be reflected.

Single-storied stands are most often associated with stand-replacement events, such as severe fires or clearcut harvesting, and are more common in younger-aged stands where understory reinitiation has not begun. Over time, these single-storied stands generally develop into multistoried stands or other more complex structures through the process of forest succession.

Two-storied stands are often associated with areas of less severe fires and usually have more fire-resistant trees, such as western larch or Douglas-fir, left in the overstory. Also, 2-storied stands frequently develop where an understory of shade-tolerant species grows under an even-aged overstory, such as subalpine fir growing under a canopy of lodgepole pine. Regeneration harvests that retain approximately 10 percent crown cover in the overstory and have a seedling/sapling understory are also classified as 2-storied stands.

The multistoried condition arises when a stand has progressed through time and succession to the point that shade-tolerant species are replacing a shade-intolerant overstory. Often a long interval of time occurs between major disturbances. Many of these stands went through a single-storied condition when younger.

Seedtree and seedtree-with-reserves harvest treatments would shift stands from their current structure class to a single-storied class. Shelterwood treatments would initially move stands from the current structure to a single story, which would again shift to a 2-storied stand upon the establishment of seedlings. Commercial-thin harvest treatments would vary depending on the current structure and the proposed timber removal. Much of the understory disturbed through logging operations and harvesting would primarily occur in the dominant, co-dominant, and intermediate canopy layers. Stand structure may be reduced by one or more classes, 2-storied or 3-storied (multistoried).

TABLE C-3 - CURRENT AND POSTHARVEST STAND STRUCTURE OF UNITS PROPOSED FOR

TABLE C-3 - CURRENT AND POSTHARVEST STAND STRUCTURE OF UNITS PROPOSED FOR HARVEST IN THE THREE CREEKS PROJECT AREA

STAND STRUCTURE	CURRENT AMOUNTS	ACTION ALTERNATIVE			
		B	C	D	E
		POSTHARVEST			
Single-storied (percent)	25	37	37	37	37
Two-storied (percent)	10	13	13	12	12
Multistoried (percent)	65	49	50	51	51
Total acres	*10,383*	*10,383*	*10,383*	*10,383*	*10,383*

HARVEST IN THE THREE CREEKS PROJECT AREA compares the current proportion of stands and the postharvest results by alternative in single-storied, two-storied, and multistoried stands within the project area.

COVERTYPE AND AGE CLASSES

EXISTING CONDITION

Covertypes describe the species composition of forest stands. Covertype representation often varies according to the frequency of disturbance. Some seral-species-dominated types, such as ponderosa pine, reflect a frequent low-intensity disturbance that helps perpetuate the shade-intolerant pine. Other types, such as the mixed-conifer type, reflect an absence of disturbance, indicating stands further along the successional pathway dominated by shade-tolerant species.

The protocol used to assign covertypes on DNRC-managed forested lands, including Swan Unit, is explained in detail in the *Rules (ARM 36.11.405) (http://arm.sos.state.mt.us/)*. The methods used to analyze current and appropriate stand conditions are described below.

Two data filters were developed to assign covertypes in a manner similar to that used in the 1930s inventory and applied to the Swan River State Forest's SLI data (*swn sliwsnc20050513; Arc View* shape file). The first, representing current conditions, followed the 1930s criteria as closely as possible. The second, representing desired future conditions, assigned covertypes using criteria to address situations where the current type may not be representative of desired conditions, such as stands where succession from one covertype to another was occurring. The desired future-condition filter indicated that those areas without fire suppression, introduced pathogens, and timber harvesting would likely have been assigned to a different covertype than the current covertype filter suggests. The filter for desired future conditions provides an assessment for the proportion of various covertypes that would likely have existed under average historic conditions.

FIGURE C-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST, FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR

FIGURE C-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST

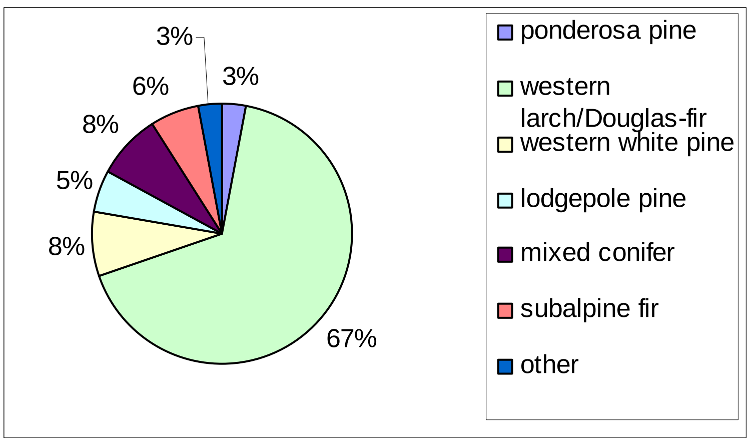
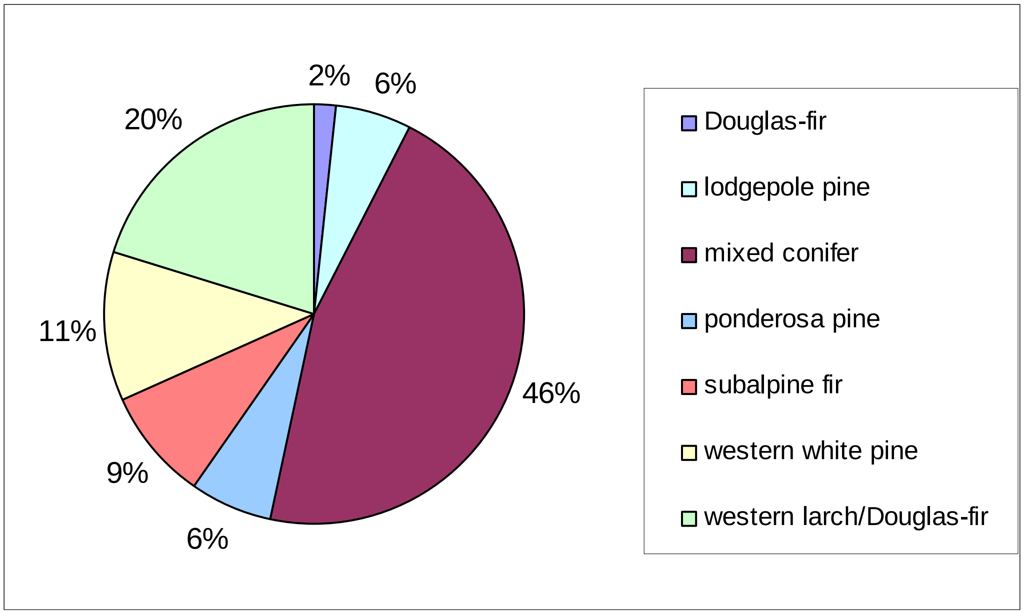


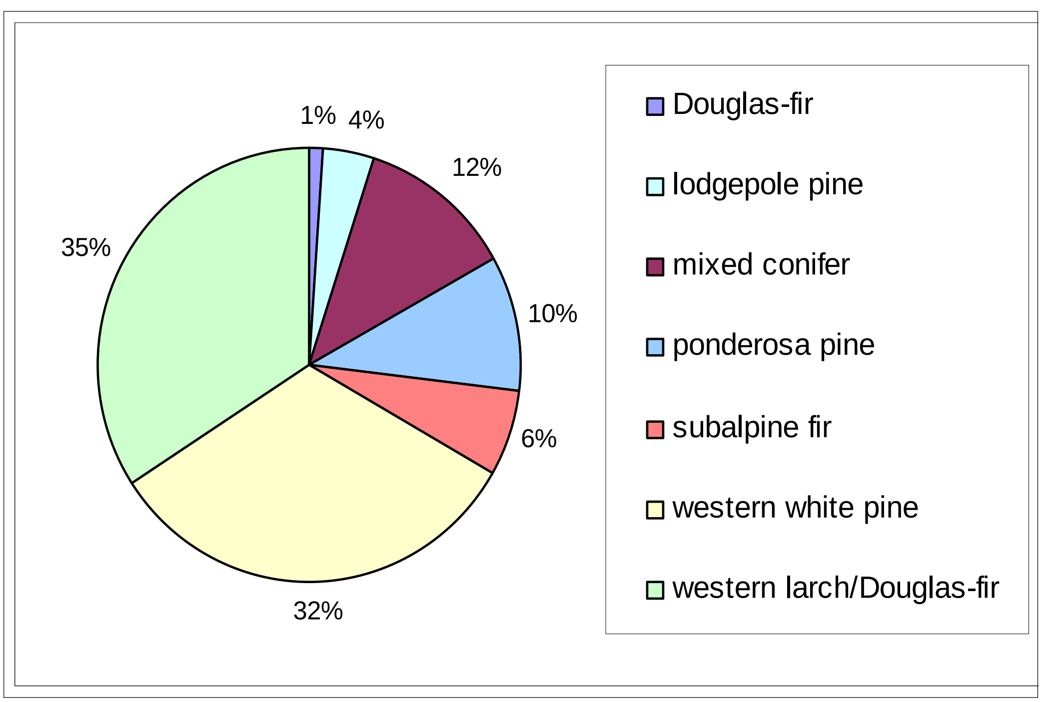
FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST



SWAN RIVER STATE FOREST, and *FIGURE C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST* illustrate the proportion of forest occupied by various covertypes at differing scales and time periods. *FIGURE C-1* shows the historical proportional representation of covertypes for Swan River State Forest.

Results indicate (*FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST* and *FIGURE C-3 - DESIRED FUTURE CONDITION BY*

FIGURE C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST



COVERTYPE ON SWAN RIVER STATE FOREST) that mixed-conifer stands are currently overrepresented compared to historic data and desired future conditions. Many of the species that compose mixed-conifer stands are shade tolerant and increase in density as the intervals between disturbances, such as wildfires, increase.

The western larch/Douglas-fir and western white pine covertypes are currently underrepresented on Swan River State Forest, in reference to desired future condition, but for different reasons. Western larch and Douglas-fir are preferred timber species that were often removed in partial or selective harvests that failed to provide suitable conditions for regenerating the species. Western larch/Douglas-fir stands have historically been perpetuated through fairly intensive disturbances, such as wildfires, and because, when mature, they are more resistant to fire mortality than other species, some individuals would survive a natural disturbance and provide a seed source for subsequent regeneration. The lack of natural disturbances has prevented regeneration of western larch across much of Swan River State Forest, particularly in the dense old stands common throughout the project area, and has resulted in a shift in dominance from shade-intolerant species, like western larch/Douglas-fir, toward more shade-tolerant species.

Data for Swan River State Forest indicates that the extent of the western white pine covertype is considerably lower than what occurred historically. White pine blister rust has drastically affected western white pine, reducing its representation across its range to less than 10 percent of historical numbers (*Fins et al. 2001*). The number of healthy western white pine that occupy the canopy as overstory dominants has been on the decline across its range for several decades despite multiorganization cooperative efforts to restore it on the landscape. So, while cooperative efforts have produced rust-resistant seed suitable for deployment throughout its range, planting has been unable to keep pace with losses due to the rust.

AGE-CLASS DISTRIBUTION

Age-class distribution delineates another characteristic important for determining trends on a landscape level. Age-class distributions are tied to covertype representation and disturbance regimes, both of which vary over the landscape in relation to prevailing climatic conditions of temperature and moisture.

Historical stand age-class distributions for Montana were developed by *Losensky (1997)*. Although the data was collected at a specific point in time, this data represents the best baseline available for determining how current forest age-class distribution deviates from historical conditions.

Comparison of the current age-class distribution by covertype across the entire Swan River State Forest to historical data from Section M333C demonstrates reduced acreage in the seedling-sapling age class and an overabundance in the 150+-year-old age class in most types (*TABLE C-4 - HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION 333C (UPPER FLATHEAD VALLEY)* and *TABLE C-5 - 1930S INVENTORY DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE FOR SWAN RIVER STATE FOREST AND TOTAL ACRES BY COVERTYPE.* The relatively old age of stands in Swan River State Forest predisposes them to attacks by insects and diseases, as well as an increased risk of stand-replacement fires.

TABLE C-4 - HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION 333C (UPPER FLATHEAD VALLEY); NONFOREST LAND IS NOT INCLUDED

COVERTYPE[1]	**NONSTOCKED**	**1 TO 40 YEARS**	**41 TO 100 YEARS**	**101 YEARS TO OLD STANDS**	**OLD STANDS[2]**
	PERCENT				
Ponderosa Pine	2	11	6	7	74
Douglas-fir	2	24	39	29	6
Western larch/ Douglas-fir	10	13	10	20	47
Western white pine	0	1	28	54	17
Lodgepole pine	21	38	29	7	5
Mixed conifer	2	4	9	42	43
Average	14	22	13	22	29

[1]The subalpine type was not assigned an age in the 1930s inventory.

[2]Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine and mixed conifer; and 140 years for lodgepole pine.

TABLE C-5 - 1930S INVENTORY DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE FOR SWAN RIVER STATE FOREST AND TOTAL ACRES BY COVERTYPE (THE AVERAGE REPRESENTS THE AVERAGE AGE-CLASS STRUCTURE ACROSS ALL COVERTYPES)

COVERTYPE	**NO AGE[1]**	**0 TO 39 YEARS**	**40 TO 99 YEARS**	**100 YEARS TO OLD STANDS**	**OLD STANDS[2]**	**TOTAL ACRES**
	PERCENT					
Ponderosa pine		0	0	0	100	1,019
Douglas-fir	100	0	0	0	0	219
Western larch/ Douglas-fir		12	7	0	81	26,253
Western white pine		0	0	0	100	3,159
Lodgepole pine		36	64	0	0	1,801
Mixed conifer	5	0	18	2	74	1,345
Subalpine fir	31	0	1	21	47	4,588
Average	5	10	8	3	74	38,668

[1]The nonage category represents land that was not typed as to age in the 1930s inventory.

[2]Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine, and mixed conifer; and 140 years for lodgepole pine.

TABLE C-6 - CURRENT SWAN RIVER STATE FOREST DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE

COVERTYPE	NO AGE[1]	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS[2]	TOTAL ACRES
	PERCENT					
Ponderosa pine		43	9	11	37	2,440
Douglas-fir		13	41	20	26	591
Western larch/ Douglas-fir		30	24	10	36	7,637
Western white pine		21	2	16	61	4,274
Lodgepole pine		7	73	20		2,255
Mixed conifer		11	12	23	54	17,257
Subalpine fir		10	19	20	51	3,282
Average		18	18	18	46	37,736

[1]The nonage category represents land that was not typed as to age in the 1930s inventory.

[2]Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine, and mixed conifer; and 140 years for lodgepole pine.

Other covertypes not included in the table: hardwoods (40 acres), nonstocked (706 acres), and nonforested (920 acres).

TABLE C-7 - CURRENT PROJECT AREA DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE

COVERTYPE	NO AGE	0 TO 39 YEARS	40 TO 99 YEARS	100 YEARS TO OLD STANDS	OLD STANDS	TOTAL ACRES
	PERCENT					
Ponderosa pine		82	0	0	18	137
Douglas-fir		15	19	66	0	59
Western larch/ Douglas-fir		25	24	10	41	2,289
Western white pine		11	0	15	74	653
Lodgepole pine		4	53	43	0	199
Mixed conifer		4	6	10	80	5,312
Subalpine fir		18	7	28	47	1,735
Average		12	11	14	63	10,384

Comparing the climatic section averages with Swan River State Forest shows that the forest was dominated by old stands to a much greater extent than was the climatic section, 74 percent old stands versus 29 percent. That trend was also demonstrated with most of the various covertypes.

The proportions of older stands have decreased when compared to historic conditions. While some of the apparent decrease amounts of old stands reflects differences in data collection and mapping protocols, the data likely reflects a real decrease, though a relatively smaller decrease than suggested by the data. The historic data indicates Swan River State Forest had avoided any major disturbances for a considerable time period. While lower amounts are shown in old stands, higher amounts are in all other age-class categories.

ALTERNATIVE EFFECTS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Covertypes and Age Classes***

  In the short term, the amount of western larch/Douglas-fir and western white pine covertypes would remain lower than DNRC’s desired future condition suggests (*FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOEST* and *C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST*). Shade-tolerant species would continue to regenerate under closed-canopy forests, increasing the ladder fuels available to carry fire to the overstory and competing with the overstory for water and nutrients. The long-term effects on covertype would continue, with a gradual loss of the seral-dominated covertypes, such as western larch/Douglas-fir and western white pine, and an increase in the mixed-conifer covertype, which is dominated by shade-tolerant species.

  No immediate change in the proportion of existing age classes (*FIGURE C-5 - CURRENT AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST*) is expected unless a large disturbance, such as a wildfire, occurs.

- ***Direct Effects of Action Alternative B to Covertypes and Age Classes***

  This alternative proposes regeneration harvests on approximately 1,331 acres using shelterwood, seedtree, and seedtree-with-reserves treatments and commercial thinning on approximately 553 acres.

  Approximately 613 acres of the mixed-conifer covertype would be converted to a western larch/Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red-cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 494 acres of the mixed-conifer covertype and 650 acres of the western larch covertype would be harvested, but no change in covertype is expected. The proportion of the western larch/Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. Approximately 127 acres within the western white pine covertype would be harvested; no change in covertype would be expected. The Douglas-fir, subalpine fir, ponderosa pine, and lodgepole pine covertypes should not experience any proportional changes.

FIGURE C-4 - HISTORIC AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST

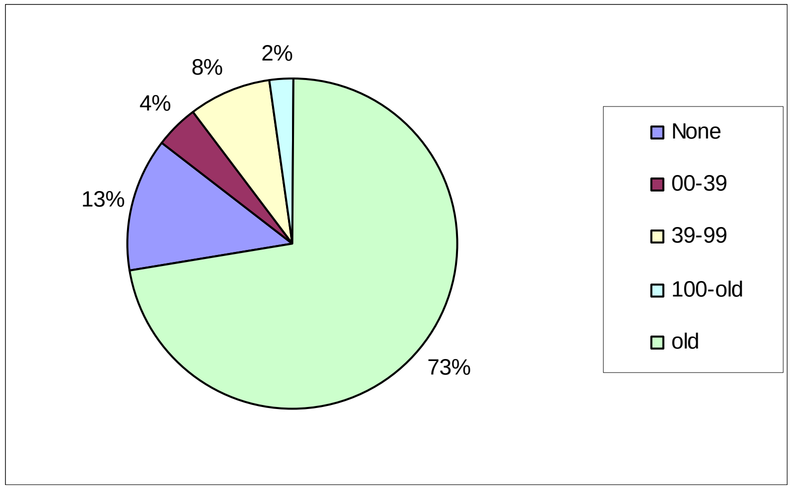


FIGURE C-5 - CURRENT AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST

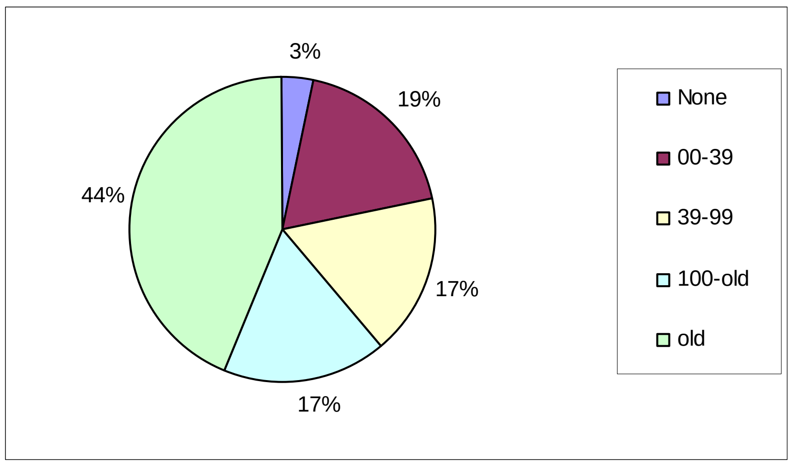


FIGURE C-6 - CURRENT AGE-CLASS DISTRIBUTION FOR THE PROJECT AREA

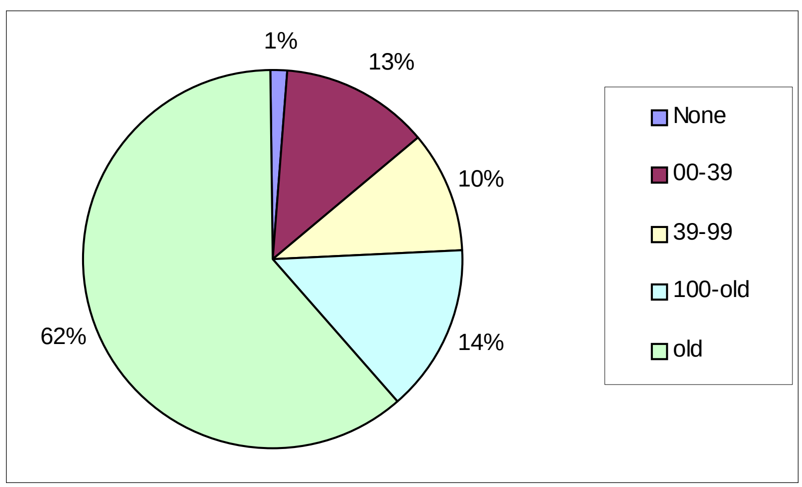
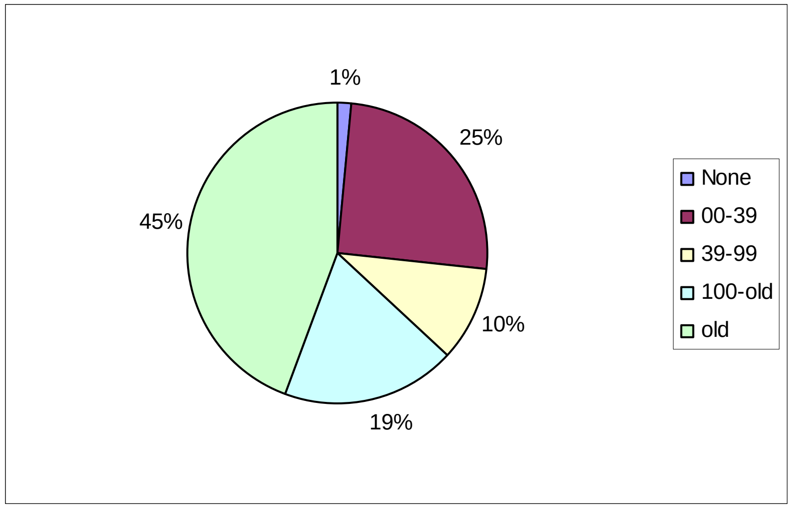


FIGURE C-7 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B



The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,331 acres; of this, 1,060 acres would be converted from the old-stand age class to the zero-year age class; the remaining 271 acres would be converted from the 100-to-150-year age class to the zero-year age class.

The 553 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in the 100-to-150-year age class, thus converting 415 acres from the old-stand age class to the 100-to-150-year age class. In addition, 6 acres would convert from the 100-to-150-year age class to the 40-to-99-year age class and 95 acres would remain in the 100-to-149-year age class following harvesting.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 0-to-39-year age class on Swan River State Forest by 3.5 percent, or 1,331 acres, while the proportion of the old-stand age class would be reduced by 3.8 percent, or 1,475 acres (*FIGURE C-7 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B*).

- ***Direct Effects of Action Alternative C to Covertypes and Age Classes***

This alternative proposes regeneration harvests using shelterwood, seedtree, and seedtree-with-reserve treatments on approximately 1,253 acres and commercial thinning on approximately 532 acres.

Approximately 660 acres of the mixed-conifer covertype would be converted to the western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red-cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 394 acres of the mixed-conifer covertype and 580 acres of the western-larch covertype would be harvested, but no change in covertype is expected. The proportion of the western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. Approximately 127 acres of western white pine and 24 acres of ponderosa pine covertypes would be harvested, but current representation should be maintained. Douglas-fir, subalpine fir, and lodgepole pine covertypes should not see any

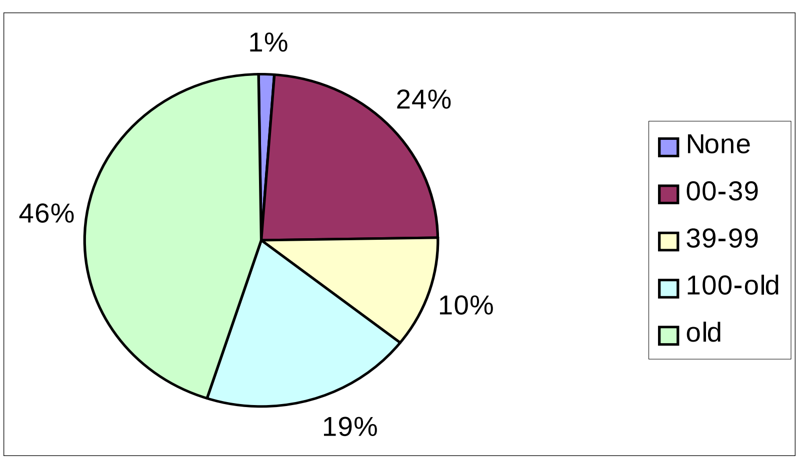
changes in percents of representation.

The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,253 acres; 988 acres would be converted from the old-stand age class to the zero-year age class, while 266 acres would be converted from the 100-to-150-year age class to the zero-year age class.

The 532 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in the 100-to-150-year and 40-to-99-year age classes. A total of 476 acres would be converted from the old-stand age class to the 100-to-150-year age class. In addition, 6 acres would convert from the 100-to-149-year age class to the 40-to-99-year age class, and 50 acres would be retained in the 100-to-149-year age class.

Regeneration treatments and the subsequent planting or natural regeneration would increase the proportion of the 0-to-39-year age class on Swan River State Forest by 3.5 percent, or 1,253 acres, while the proportion of the old-stand age class would be reduced by 3.8 percent, or 1,464 acres (*FIGURE C-8 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE C*).

FIGURE C-8 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLCATION OF ACTION ALTERNATIVE C



- ***Direct Effects of Action Alternative D to Covertypes and Age Classes***

This alternative proposes regeneration harvests by using shelterwood, seedtree, and seedtree-with-reserves treatments on approximately 1,410 acres and commercial thinning on approximately 560 acres.

Approximately 633 acres of the mixed-conifer covertype would be converted to the western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red-cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 529 acres of the mixed-conifer covertype and 595 acres of the western larch covertype would be harvested, but no change in covertype is expected. The proportion of western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. The western white pine, subalpine fir, and ponderosa pine covertype proportions should remain similar to current values, while the Douglas-fir and lodgepole pine covertypes should not experience any proportional changes.

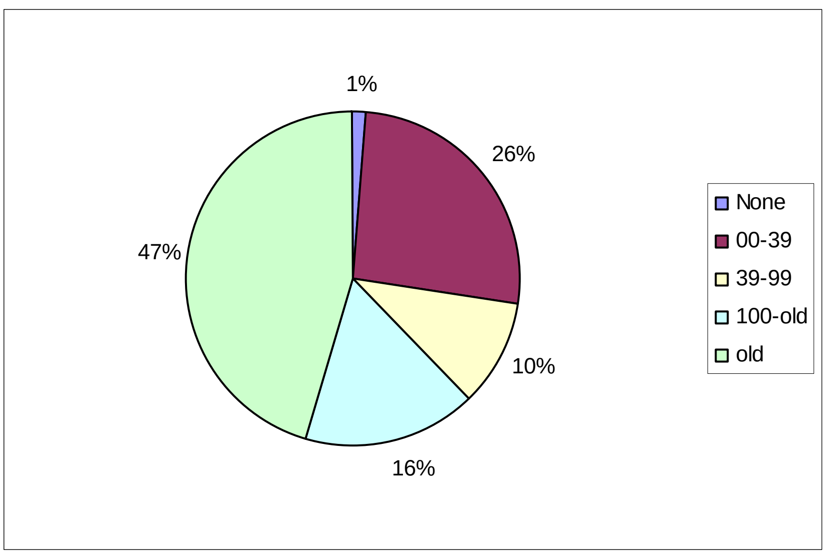
The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,410 acres; of this, 1,055 acres would be converted from the old-stand age class to the zero-year age class, and the remaining 355 acres would be converted from

the 100-to-150-year age class to the zero-year age class.

The 560 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in the 100-to-150-year and 40-to-99-year age classes. A total of 457 acres would be converted from the old-stand age class to the 100-to-150-year age class. In addition, 8 acres would convert from the 100-to-150-year age class to the 40-to-99-year age class, and 95 acres would be retained in the 100-to-150-year age class.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 0-to-39-year age class on Swan River State Forest by 3.7 percent, or 1,410 acres, while the proportion of the old-stand age class would be reduced by 3.9 percent, or 1,512 acres (*FIGURE C-9 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE D*).

FIGURE C-9 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE D



- ***Direct Effects of Action Alternative E to Covertypes and Age Classes***

This alternative proposes regeneration harvests by using shelterwood, seedtree, and seedtree-with-reserves treatments on approximately 1,371 acres and commercial thinning on approximately 628 acres.

Approximately 550 acres of the mixed-conifer covertype would be converted to the western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 451 acres of the mixed-conifer covertype and 735 acres of the western larch covertype would be harvested, but no change in covertype is expected. The proportion of western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. The western white pine and subalpine fir covertype proportions should remain similar to current values, while the Douglas-fir, ponderosa pine, and lodgepole pine covertypes should not experience any proportional changes.

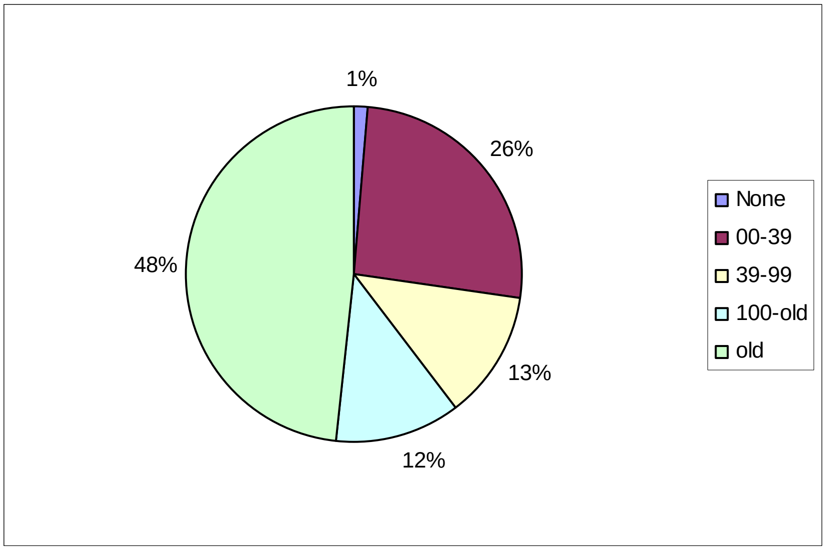
The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,371 acres; of this, 891 acres would be converted from the old-stand age class to the zero-year age class, and the remaining 461 acres would be converted from the 100-to-150-year age class

to the zero-year age class. Additionally, 19 acres would convert from the 40-to-99-year age class to the zero-year age class.

The 628 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in the 100-to-150-year and 40-to-99-year age classes. A total of 260 acres would be converted from the old-stand age class to the 100-to-150-year age class. In addition, 211 acres would convert from the 100-to-150-year age class to the 40-to-99-year age class and 157 acres would be retained in the 100-to-150-year age class.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 0-to-39-year age class on Swan River State Forest by 3.5 percent, or 1,352 acres, while the proportion of the old-stand age class would be reduced by 2.99 percent, or 1,151 acres (*FIGURE C-10 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE E*).

FIGURE C-10 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE E



Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Covertypes and Age Classes***

  Forest succession, driven by the impacts of forest insects and diseases when fires are being suppressed, would reduce the variability of covertypes and age classes. As the forest ages and composition become more homogeneous, biodiversity would be reduced.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Covertypes and Age Classes***

  All action alternatives apply a variety of silvicultural treatments to stands across the project area. The types of treatments include commercial thinning, seedtree, seedtree-with-reserves, and shelterwood.

  Across the project area, the forest would contain a mosaic of structures to include single-storied, two-storied, and multistoried conditions. The structure changes through harvesting would emulate fire disturbance that historically occurred within the project area. Fire disturbance emulations would range from stand replacing to mixed severity to light underburns.

  Seedtree and seedtree-with-reserves harvesting would be applied under all action alternatives. This prescription emulates a stand-replacement fire because the largest share of trees would be harvested. Some fire effects would be applied when slash is piled and burned or broadcast burned. Most regeneration would be western larch, Douglas-

fir, ponderosa pine, and western white pine, which is similar to what would be expected following a fire. The majority of seedtrees retained would be the larger diameter, fire-tolerant western larch, Douglas-fir, and, where available, ponderosa pine that have some resistance to burning.

Commercial thinning treatments would be applied under all action alternatives. This prescription emulates the effects of low-intensity fires with flare-ups that are common in the mixed-severity fire regime. Harvesting would retain approximately 80 to 110 trees per acre, or 40 to 50 percent canopy coverage. The species retained would primarily consist of shade-intolerant species that move the forest towards desired future conditions for the area. Individual trees remaining in the stand would have more light and nutrients available for continued growth and vigor.

Shelterwood harvesting would occur under all action alternatives. This prescription would emulate a mixed-severity or moderate-intensity fire. Harvesting would concentrate on shade-tolerant species, individuals affected by insects or diseases, and those less desirable for the desired future conditions. Regeneration would be western larch, Douglas-fir, and ponderosa pine or western white pine where appropriate for the site conditions.

Over time, untreated stands would advance in age class and gradually shift towards covertypes with more shade-tolerant species. Treated stands would also advance in age class and, in the long term, could shift toward covertypes with more shade-tolerant species.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Covertypes and Age Classes***

The cumulative effects of recent forest management on Swan River State Forest resulted in a trend of increasing seral covertypes across areas where management occurred. For example, the Goat Squeezer Timber Sale Project in 2003 through 2006 increased the western larch/Douglas-fir covertype on Swan River State Forest by 11 percent through timber harvesting and planting in selected units.

In addition to the changes in proportions of covertype proposed in the various action alternatives, other timber sale projects have been initiated, but not completed, and, therefore, their effects are not represented in the *swn sliwsnc20050513* data. Scheduled updates of the SLI would capture increased western larch/ Douglas-fir covertypes on Swan River State Forest, as well as the trend toward increasing acres in the 0-to-39-year age class.

The Cilly Bug Salvage Timber Sale removed dead, dying, and infected Douglas-fir and western larch. The Three Creeks Timber Sale Project would enter 3 of the stands and remove additional trees. The primary species to be harvested is grand fir, which is heavily infected with Indian paint fungus. Other permits are currently in the process of being harvested; age class or covertype of these stands would not be affected.

The cumulative effects to age-class distributions due to previous activities on Swan River State Forest are represented in descriptions of the current condition. Generally speaking, those effects have been to reduce the acres in old age classes while increasing the acres in the

TABLE C-8 - POSTHARVEST AGE-CLASS DISTRIBUTION, IN PERCENT, BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION

		AGE CLASSES				
		0 TO 39 YEARS	**40 TO 99 YEARS**	**100 TO OLD STANDS**	**OLD STANDS**	**TOTAL ACRES**
Western larch/ Douglas-fir	Current	25	24	10	41	2,289
	Action Alternative B	49	19	20	12	2,867
	Action Alternative C	45	18	20	17	3,011
	Action Alternative D	48	19	19	14	2,924
	Action Alternative E	53	22	12	13	2,812
Western white pine	Current	11		15	74	653
	Action Alternative B	11		34	55	653
	Action Alternative C	11		34	55	653
	Action Alternative D	11		22	67	672
	Action Alternative E	24		14	62	653
Mixed conifer	Current	3	6	11	80	5,312
	Action Alternative B	14	7	12	67	4,653
	Action Alternative C	10	6	11	73	5,312
	Action Alternative D	12	6	10	72	5,312
	Action Alternative E	8	9	7	76	5,312
Subalpine fir	Current	18	7	28	47	1,735
	Action Alternative B	18	7	28	47	1,735
	Action Alternative C	18	7	28	47	1,735
	Action Alternative D	26	7	20	47	1,735
	Action Alternative E	26	7	20	47	1,735
Ponderosa pine	Current	82			18	137
	Action Alternative B	82			18	137
	Action Alternative C	82		18		137
	Action Alternative D	82		18		137
	Action Alternative E	82		18		137

Only affected covertypes were included in the table.

younger age classes versus the snapshot of the forest represented in the 1930s inventory. Regarding long-term sustainable conditions, the Department's process indicates the movement of acres from older to younger age classes is in keeping with a movement toward average historical conditions.

CANOPY COVER

EXISTING CONDITION

Canopy cover, an estimate of the ratio between tree crown area and ground surface area, is usually expressed in terms of percent and is another measure of stand stocking/ density. Categories used to describe canopy cover include well stocked, medium stocked, poorly stocked, nonstocked, and nonforested.

The SLI database has a rating for overall canopy cover and one for sawtimber canopy cover in the stand. In terms of overall canopy cover within the project area, 72.4 percent of stands are well-stocked, 17.9 percent show medium stocking, and less than 10 percent are poorly stocked or nonstocked. Sawtimber stocking within the project area shows that 45.5 percent of stands are well stocked, while 18.7 percent of stands have medium sawtimber stocking. The poorly stocked category consists of a minor proportion of the project area and the associated stands are typically in higher elevation, which have high quantities of rock and/or brush. Timber in these stands is generally not of good merchantable quality.

ALTERNATIVE EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Canopy Cover***

  No-Action Alternative A would not change the canopy cover in the short term. Over time, individuals and groups of trees would be removed from the canopy by insects, diseases, windthrow, or fires and would result in variable changes to canopy cover as canopy gaps are created and gradually filled. Patches of variable size currently exist where the Douglas-fir beetle has killed large Douglas-fir.

  Canopy cover would likely increase over time in the absence of disturbances. Were large fires to occur, canopy cover would be reduced. Ongoing insect and disease issues would reduce canopy cover in some areas prior to understory reinitiation.

- ***Direct Effects of Action Alternatives B, C, D, and E to Canopy Cover***

  The reduction in canopy cover subsequent to harvest treatments would vary by action alternative and its silvicultural prescription. In general, reduced canopy cover affects stand growth and development in various ways. First, competition among the crowns of overstory trees is reduced, allowing accelerated volume growth and increased seed production. Second, competition for water and nutrients is reduced, thus allowing trees to be more resistant to both drought and bark beetle attacks. Third, a more diverse and vigorous understory is able to establish. Finally, sunlight is allowed to reach the forest floor, which, along with seedbed preparation, is of particular importance to the successful regeneration of seral species such as western larch and western white pine. For this analysis, the residual canopy cover includes both the overstory and understory tree canopies remaining after harvesting, including both merchantable and submerchantable trees.

  In areas with seedtree or seedtree-with-reserve harvesting, the canopy coverage would decrease to between 10 to 25 percent, with

the exception of the reserve areas where the canopy would remain intact. In the shelterwood harvesting, the canopy would decrease to between 15 and 45 percent. Commercial thinning would decrease the canopy coverage to between 40 and 50 percent.

Riparian stands associated with perennial streams and adjacent to harvest units would be treated and experience reduced canopy coverage. The designated primary streams that would be treated are South Fork Lost, Soup, and Cilly creeks and an unnamed tributary in Section 22, T24N, R17W. A 300-foot buffer (150 feet on each side of the stream) would be identified along the primary streams where harvesting is to occur on both sides of the stream or a lack of mature timber (pole-sized or larger with a minimum of 40 percent crown closure) is on the opposite side of the stream from the harvest unit. In areas where harvesting is proposed on one side of the stream and the opposing side has mature timber, the buffer would be 100 feet. Within the buffer a 25-foot no-harvest zone would be delineated from the bankfull or high-water edge to 25 feet. From 25 to 150 feet (from bankfull edge), selective harvesting would occur. A maximum of 50 percent of the trees 8 inches dbh and greater may be harvested while maintaining a minimum of 40-percent overstory crown closure.

All other streams within or adjacent to a harvest unit would be managed in accordance with the SMZ law. Buffers would be 100 or 200 feet wide (50 or 100 feet each side of the stream), with a 25-foot no-harvest zone beginning at the bankfull edge.

Additionally, some harvesting would occur within the RMZ, but outside the SMZ. Small openings up to 0.25-acre in size would be allowed as long as 40-percent average canopy closure could be achieved throughout the affected area.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Canopy Cover***

  Canopy cover would increase over time as regeneration replaces the harvested trees in stands that received seedtree and shelterwood treatments. Fifteen to twenty years would be needed to develop 70- to 100-percent canopy cover.

  Canopy cover in commercially thinned stands would return to preharvest conditions in approximately 20 to 30 years, depending on the level of removal.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Canopy Cover***

  Current canopy cover would remain the same across the forest. Over time, canopy cover would be expected to increase in the absence of disturbance. Mortality of trees or groups of trees, when it occurred, would reduce the canopy coverage in localized areas. Large reductions in canopy cover would occur if a large fire came through the area.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Canopy Cover***

  Overall reductions of canopy cover in well-stocked stands would be reduced. Representation of medium-stocked stands would increase following harvest prescriptions, as would poorly stocked stands. As stands regenerate, canopy cover would increase.

FRAGMENTATION

EXISTING CONDITION

Forest fragmentation refers to the breaking up of previously contiguous blocks of forest. Most often, fragmentation is used in reference

to the disruption of large contiguous blocks of mature forest caused by forest-management activities such as road building and timber harvesting. In relation to fragmentation, management activities begin by putting holes in the natural forested landscape (i.e., chunks of the forest are removed via harvesting, thus creating patches of nonmature forest within a background matrix of mature forest). As management continues and more harvesting takes place, the open patches created can become connected to other open patches, thus severing the previously existing connections between patches of mature forest. While the appropriate level of fragmentation for any particular forest is unknown, forests fragmented by management activities generally do not resemble natural forest conditions.

Historically, wildfires burned with varying intensities, return intervals, and to different sizes across Swan River State Forest, which interacted with insect and disease activities to create a mosaic of forest covertypes and age classes. Today, forest management is the primary agent influencing fragmentation. Were they to occur, intense fires during extreme fire seasons would influence fragmentation across the landscape, as would insect and disease activities.

The majority of the project area exists as a contiguous forest of well-stocked stands with closed canopies. Stands in the western part of the project area have been fragmented to some degree. Some man-made patches in harvest units range from 20 to 100 acres. Refer to *Connectivity* analysis in *APPENDIX F – WILDLIFE ANALYSIS* for an assessment of fragmentation effects on closed-canopy forests. Refer to patch size of age classes, old growth, and covertype in this analysis for additional indications of the effects of forest fragmentation.

ALTERNATIVE EFFECTS TO FRAGMENTATION

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Fragmentation***

  No direct effects to forest fragmentation would occur from No-Action Alternative A. Over time, and depending on an unknown future, indirect effects would include a reduction in fragmentation as additional harvesting is not imposed by management and existing patches of nonmature forest grow to maturity.

- ***Direct Effects of Action Alternatives B, C, D, and E to Fragmentation***

  For the areas proposed for regeneration harvesting, the primary effects would be creating a larger area of younger stands with a corresponding reduction in mature forest stands. In the stands designated for seedtree reserves, one or more patches (ranging in size from 1.7 to 4 acres) would be untreated, but the treatment would contribute to the fragmentation of mature forests and would reduce the distance between open- and closed-canopy stands.

  The units designated for commercial thinning would show less fragmentation of the canopy layer. Commercial-thin units would be more similar to adjacent mature stands of timber than would the regeneration harvest units and, therefore, would not contribute to fragmentation. In the case where a commercial-thin unit requires helicopter or cable systems for harvesting, the openings may resemble gaps created by small areas of crown torching that occur during low-intensity fires; however, they would not contribute to fragmentation.

Indirect Effects

- ***Indirect Effects of Action Alternatives B, C, D, and E to Fragmentation***

  Some regeneration harvest units are adjacent to past harvest areas and other proposed units, which would result in an enlargement of younger age-class patches. The end result would be more of a blended geometric shape of larger regeneration units. The large size of regeneration units would result in larger mature stands in the future, thus reducing fragmentation. However, future timber harvesting would result in additional fragmentation if existing mature timber patches received a regeneration harvest. The actual net effect on fragmentation would depend on future timber harvesting.

  In units where commercial-thin treatments would be accomplished, the harvesting would result in smaller differences between adjacent stands and would not contribute to fragmentation.

Cumulative Effects

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Fragmentation***

  An overall increase in the size of younger age-class patches and a decrease in the size of older age classes would occur where regeneration harvest units are proposed. See the discussion on age classes for acres that would change by alternative. Small Squeezer, Small Squeezer II, South Woodward, and Goat Squeezer timber sales have added to the fragmentation of the forest. The stands that primarily contributed to fragmentation are the regeneration units. Units that involve thinning treatments did not provide harsh breaks in the canopy, but a reduced canopy cover. The aerial view shows the differences from one unit to the other from the point of stand density, but do not necessarily differ from the point of age class.

INSECTS AND DISEASES

BACKGROUND

Planning for the long-term management of forest insects and diseases is an important part of designing project-level timber sales. Various forest-species compositions and structures are more vulnerable to certain insects, diseases, windthrow, and wildfire than others (*Byler and Hagle 2000*). Identifying stands with the most vulnerable compositions and structures and developing suitable management plans can help alleviate future problems that may prevent achievement of long-term forest-management objectives.

ANALYSIS METHODS

Swan River State Forest undergoes an annual aerial survey in order to map forest insect and disease problems, outbreaks of the bark beetle,in particular. DNRC and USFS provide a report of the survey to Swan River State Forest; in addition to investigating these reports, DNRC personnel include their own observations of forest conditions.

The focus on the Three Creeks Timber Sale Project would include:

- the effects of insects and diseases;
- existing conditions in relation to the project or harvest areas;
- management recommendations; and
- potential losses of sawlog value to the trusts.

ANALYSIS AREA

The analysis area is primarily within the Three Creeks Timber Sale Project area. The major forest insects and diseases currently affecting forest productivity include:

<u>Diseases</u>:

Armillaria root disease (*Armillaria ostoyae*)
Red-brown butt rot (*Phaeolus schweinitzii*)
Larch dwarf mistletoe (*Arceuthobium laricis*)
White pine blister rust (*Cronartium ribicola*)
Indian paint fungus (*Echinodontium tinctorium*)
Red ring rot (*Phellinus pini*)

<u>Insects</u>:

Douglas-fir bark beetle (*Dendroctonus pseudotsugae*)
Fir engraver (*Scolytus ventralis*)
Mountain pine beetle (*Dendroctonus ponderosae*)

➢ ***Armillaria Root Disease***

Armillaria root disease, caused by the fungus *Armillaria ostoyae,* is a common pathogen of conifers in western North America. Stands impacted by Armillaria root disease occur throughout the Three Creeks Timber Sale Project area.

Armillaria ostoyae spreads mainly via root contacts, but also through a short distance growth of rhizomorphs through soil (*Redfern and Filip 1991*). The fungus colonizes the root collar, kills the cambium, and eventually girdles the tree, which causes mortality. Viable *Armillaria ostoyae* inoculum can persist in below-ground portions of stumps and large roots for decades (*Roth et al. 1980*). Conifers exhibit variations both in response to infection by *Armillaria ostoyae* (*Robinson and Morrison 2001*) and susceptibility to mortality (*Hadfield et al. 1986*). Species susceptibility and damage ratings for Armillaria root disease in western Montana are:

- severe damage: Douglas-fir, grand fir, subalpine fir
- moderate damage: ponderosa pine, lodgepole pine, western white pine
- infrequent damage: western larch and western red cedar.

Western larch, in particular, shows increasing resistance to *Armillaria* beyond age 15 (*Morrison et al. 1991*) and is colonized by root lesions less frequently than comparably aged Douglas-fir (*Robinson and Morrison 2001*). All conifers should, however, be considered equally susceptible to *Armillaria ostoyae* before ages 15 to 20 (*Hadfield et al. 1986; Morrison et al. 1991*).

Silvicultural approaches that emphasize seral species are recommended even for stands with low levels of Armillaria root disease (*Filip and Goheen 1984; Morrison and Mallett 1996*). Selective cutting in such stands is the least favorable option as it would likely result in an increased inoculum load in the form of *Armillaria ostoyae*-colonized root systems, dispersed among the remaining crop trees (*Morrison et al. 2001; Morrison and Mallett 1996*). In mixed-species stands composed of shade-intolerant, early-seral species and shade-tolerant, late-successional species, the seral species should be favored during intermediate stand entries in order to limit the root-to-root pathways between more readily damaged species. In stands where root disease is a factor, natural regeneration should be utilized, if possible, because planted trees seldom show the resistance displayed by naturally regenerated

trees (*Morrison et al. 2000; Rizzo et al. 1995*).

- ***Western Larch Dwarf Mistletoe***

Western larch dwarf mistletoe, caused by *Arceuthobium laricis*, is considered the most important disease of western larch in the Inland West (*Beatty et al. 1997*). Dwarf mistletoes are parasitic plants that obtain moisture and nutrients from their hosts, resulting in a reduction in tree vigor, growth, and seed production. Infections greatly decrease the growth of western larch; 10-year, basal-area growth of trees in western Montana classed as lightly, moderately, and heavily infected was decreased 30, 42, and 65 percent, respectively, compared to that of an uninfected western larch (*Pierce 1960*).

The life cycle of dwarf mistletoe is generally 4 to 6 years in length, depending on the species. Dwarf mistletoes spread when seeds from the female mistletoe plants are forcibly dispersed, often for 10s of feet, in the late summer and fall; seeds that land on susceptible hosts germinate the following spring and infect the host tissues. Infections on western larch eventually cause branches to form dense clumps of twigs and branches known as “witches’ brooms”. In western larch these brooms are brittle and prone to break off under snow load, thus leading to gradual, top-down decline of the tree as more and more branches are lost. In addition, infection by dwarf mistletoe increases moisture stress in its host, more so when a drought is in progress, adding to the likelihood of top-down decline and attack by wood borers (*Gibson 2004*).

The incidence and severity of western larch dwarf mistletoe appears to be highly variable across the Three Creeks Timber Sale Project area. This variation most likely reflects a complex history of mixed-severity and stand-replacing fires in these forests. Such fires would variously leave both mistletoe-infected and noninfected trees to provide seed for the next generation. Depending on the spatial distribution of infected, seed-bearing trees following fires, western larch regeneration might: 1) remain free of infection, 2) have a substantial lag-time prior to infection, or 3) become infected early in development. The earlier a tree becomes infected by dwarf mistletoe, the greater the impacts.

Due to the seeding habit of dwarf mistletoes, spread and intensification are at their worst when an infected overstory exists over the regeneration of the same tree species. Seedtree or shelterwood treatments can still be carried out in stands that have dwarf mistletoe infections in the overstory, but tree selection in such instances needs to discriminate against the most heavily dwarf-mistletoe-infected western larch and leave as many noninfected or lightly-infected trees as possible (*Beatty et al. 1997*).

To minimize dwarf mistletoe infection in larch regeneration, the infected overstory trees should be removed or killed once western larch regeneration is established and before regeneration reaches the age of 7 years old or 3.3 feet in height (*Mathiasen 1998*).

- ***White Pine Blister Rust***

Western white pine has declined as a component of the mixed-conifer forest in which it occurred historically on Swan River State Forest. The primary cause is

white pine blister rust, a disease caused by the nonnative fungus *Cronartium ribicola*, which can infect and kill white pine of all ages and sizes. Dominant or co-dominant western white pine that are infected are often top-killed since the fungus first infects needles before growing down the infected branch and, eventually, girdling the bole. The portion of crown above such a bole infection will die once the stem is girdled.

Some western white pine remain on Swan River State Forest because either they possess natural genetic resistance to the rust or have not been infected. Retention of various numbers of mature, seed-bearing western white pine is encouraged in order to maintain genetic diversity of the species and promote natural regeneration where possible (*Schwandt and Zack 1996*). Once mature western white pine are top-killed by rust, however, their seed-producing capacity is often very limited or eliminated, and such trees can then be considered for salvage or retention as snags (*Schwandt and Zack 1996*).

Western white pine are susceptible to attack by the mountain pine beetle (*Dendroctonus ponderosae*), even when existing as relatively isolated individuals or small groups in mixed-conifer stands; damage from this bark beetle is chronic in the Inland Empire.

Management and restoration recommendations for western white pine emphasize planting rust-resistant western white pine seedlings and maintaining white pine genetic diversity (*Fins et al. 2201*).

The monitoring of rust levels should be performed at various times in the life of a stand; bole pruning to reduce the chances of blister rust infections may be required if rust levels are high when the stand is young.

- ***Indian Paint Fungus***

Indian paint fungus, so called because Native Americans used the brick-red interior of the fruiting body in making pigment, is a true heartrot that very commonly infects true firs and hemlocks. This fungus is the predominant cause of heartrot and volume losses in these species in western North America (*Hansen and Lewis 1997*). True heartrots, generally confined to the heartwood of trees, consistently produce fruiting bodies or conks on the stems of living trees and do not rely on mechanical wounding as their principal infection court (*Ethridge and Hunt 1978*). Large diameter grand fir with decay caused by Indian paint fungus are important habitat, both while standing and down, for various species of cavity-nesting birds and mammals (*Bull et al. 1997*).

Trees are infected with *Echinodontium tinctorium* spores via very small branchlet stubs. The spores germinate before the infection goes dormant after being overgrown by the tree, and can then stay dormant for decades (*Maloy 1991*). Heaviest infections tend to occur in advanced regeneration growing under an infected overstory. Growth of the fungus is reactivated when the tree is wounded either naturally or mechanically, develops frost cracks, or is otherwise physiologically altered. The fungus causes extensive decay of the heartwood and, over time, these trees become more susceptible to stem collapse. A rule of thumb is that one conk on the stem of a tree indicates approximately 16 feet of extensive heartwood decay in either direction, while several conks on the stem of a tree indicate that the tree is a cull. In the Three

Creeks Timber Sale Project area, Indian paint fungus is well distributed on grand and subalpine firs. Stand exams and reconnaissance surveys reveal a 30- to 40-percent infection rate. To reduce losses from this pathogen, management recommendations include (*Filip et al. 1983*):

- keeping rotations of susceptible species under 150 years unless the amount of infection is light;
- thinning early;
- selecting the most vigorous nonwounded trees for residuals; and
- minimizing wounding of susceptible hosts when thinning, prescribed burning, or performing any silvicultural treatments.

➢ ***Red-Brown Butt Rot***

Red-brown butt rot is caused by the root-infecting pathogen *Phaeolus schweinitzii*. Any conifer can be a host, but infection is considered of primary importance in Douglas-fir. Instead of affecting trees in groups, as do root diseases such as Armillaria root disease, red-brown butt rot tends to affect trees on an individual basis (*Hansen and Lewis 1997*). The fungus can, however, cross from tree-to-tree at root grafts and contacts. Most damage occurs in stands more than 80 years of age. The pathogen infects via small roots and causes decay in the interior of the roots. This decay extends into the butt log an average of eight feet, making such trees susceptible to stem collapse and windthrow. Since most are green when windthrown, the trees provide prime habitat for Douglas-fir and other bark beetles. Management options are limited. Rotations can be shortened to about 90 years in Douglas-fir to minimize loss due to decay, and less-affected host species can be emphasized over Douglas-fir.

➢ ***Douglas-Fir Bark Beetle***

The Douglas-fir bark beetle has been active in recent years across Swan River State Forest. The project area has an elevated incidence of the Douglas-fir bark beetle in areas proposed for harvesting. In general, stands that are at highest risk to attack by the Douglas-fir bark beetle are those with (*USDA Forest Service 1999)*:

- basal areas greater than 250 square feet per acre;
- an average stand age greater than 120 years;
- an average dbh greater than 14 inches; and
- a stand composition greater than 50-percent Douglas-fir.

Douglas-fir within most of the proposed harvest areas on the Three Creeks Timber Sale Project area are at high risk of Douglas-fir bark beetle attack due to age, size, and stocking. Low, or endemic, populations of Douglas-fir bark beetles tend to exist in fresh blowdown, fire-killed trees, or live trees within and around pockets of root disease (*Livingston 1999; Schmitz and Gibson 1996*). Management of the Douglas-fir bark beetle should concentrate on the removal of windthrown Douglas-fir and the salvage of newly attacked trees before adult beetles can emerge (*Livingston 1999; Schmitz and Gibson 1996*). Valuable Douglas-fir (e.g. those in and around campgrounds) that are considered to be at high risk can be protected by use of the Douglas-fir bark beetle anti-aggregant pheromone 3-methylcyclohex-2-en-1-one (*Ross et al. 2001*).

Numerous pockets of infestations were located within the analysis area in 1999. Each spring following the flight of the

beetle, reconnaissance surveys were conducted by DNRC foresters to determine the extent of infestations. (See *Figure C-11 - DOUGLAS-FIR BEETLE ACTIVITY 2000 THROUG 2004 IN THE VICINITY OF THE THREE CREEKS TIMBER SALE PROJECT, ALL ALTERNATIVES COMBINED.*) The beetle was estimated to have caused heavy Douglas-fir mortality on approximately 2,500 acres. The Swan River State Forest timber permit program allowed for the salvage harvesting of approximately 2 mmbf of sawlogs in 1999, 600 mbf in 2000, and 500 mbf in 2001.

- ***Fir Engraver***

The fir engraver, *Scolytus ventralis*, has recently killed many grand and subalpine firs in the Swan Valley. This bark beetle is wide-ranging across the west, attacking primarily grand fir (*Ferrell 1986*). Endemic populations of fir engraver beetles are closely associated with root disease or other factors that stress its hosts; they rarely make successful attacks on vigorous grand fir (*Goheen and Hansen 1993*). However, when grand fir and other preferred hosts become stressed during periods of drought, the fir engraver can begin attacking otherwise healthy trees across the landscape, and the association with root disease becomes less distinct (*Goheen and Hansen 1993*).

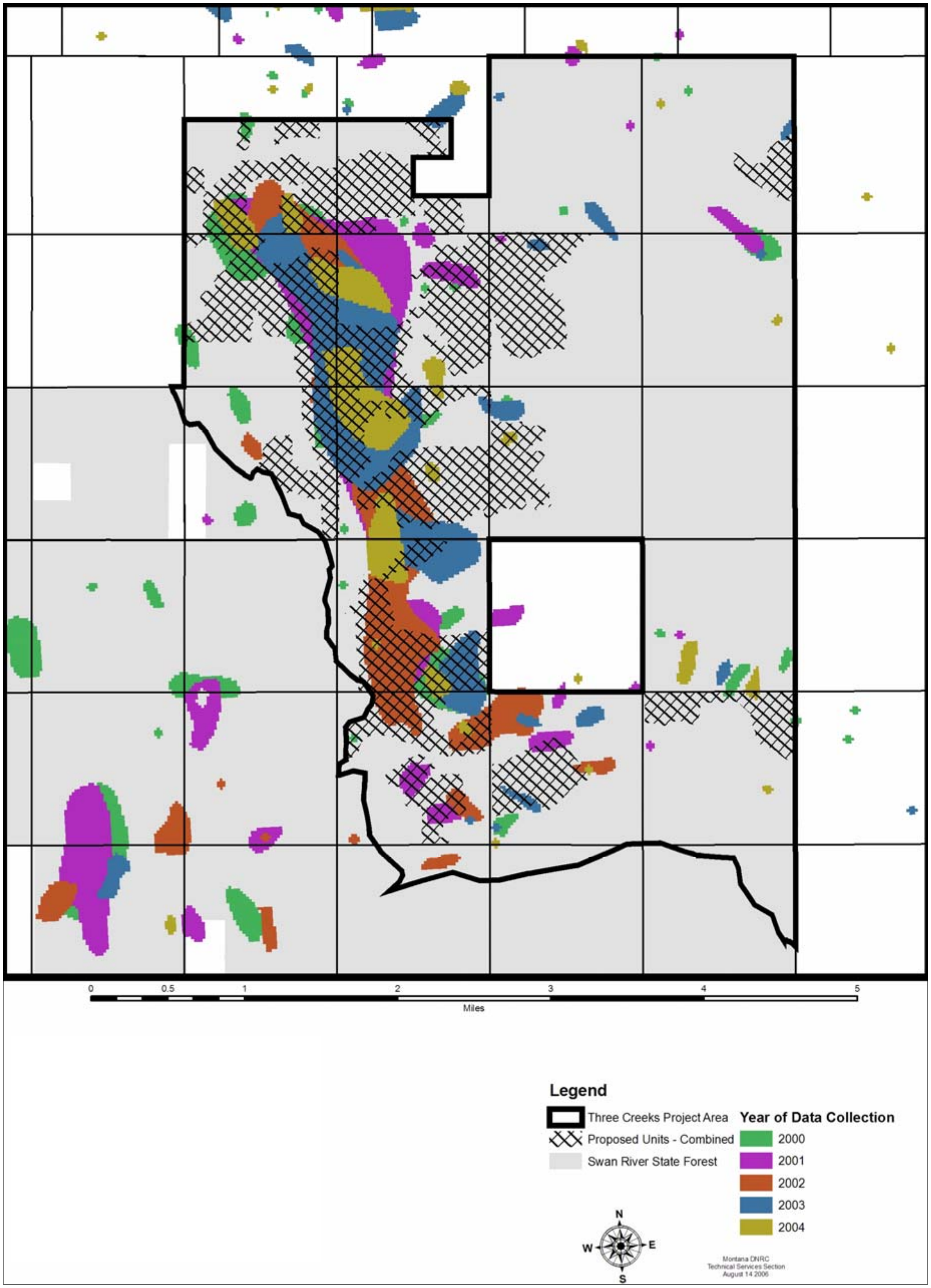
Management of the fir engraver is problematic. Silvicultural practices that promote the vigor of grand fir stands - thinning, for example - would also reduce the chances of extensive damage during periods of drought (*Ferrell 1986*). Management practices aimed at reducing the impact of root diseases would also help lessen the long-term impacts of the fir engraver. Such practices include the promotion of less root-disease-susceptible species, such as western larch, western white pine, and ponderosa pine, in areas with extensive root disease.

- ***Mountain pine beetle***

Mountain pine beetle (*Dendroctonus ponderosae*) is a native North American bark beetle with four major hosts, one being western white pine (Amman et al. 1989). Historically, when extensive stands of mature western white pine still existed, mountain pine beetle outbreaks could kill a large majority of trees just as the mountain pine beetle does today in extensive stands of lodgepole pine. The occurrence of pitch tubes along the bole is one way to determine if attacks by mountain pine beetles have occurred. Pitch tubes on successfully attacked trees are generally very numerous, one-fourth to one-half inch in diameter and consist of cream- to dark-red-colored masses of resin mixed with frass. Pitch tubes on unsuccessfully attacked trees are widely scattered over the bole of the tree, three-quarters to one inch in diameter, and mostly cream-colored. Confirmation of a mountain pine beetle attack can be done by looking for the characteristic gallery patterns on the inner side of the bark. Bark beetles attacking western white pine also introduce aggressive blue-stain fungi that grow into the sapwood and contribute to the death of the tree.

Mountain pine beetles produce one generation per year, though sometimes pupae or brood adults will last longer at higher elevations. The beetles overwinter mostly as larvae within the egg galleries, then maturate and emerge as adults to attack more trees from June through August. The foliage of trees that have been successfully attacked during the current year can change color anywhere from a few months to a year later. Therefore,

FIGURE C-11 - DOUGLAS-FIR BEETLE ACTIVITY 2000 THROUGH 2004 IN THE VICINITY OF THE THREE CREEKS TIMBER SALE PROJECT, ALL ALTERNATIVES COMBINED



mountain pine beetle brood trees that have been attacked the previous summer and removed during late winter or spring salvage operations may still have green foliage.

ALTERNATIVE EFFECTS TO INSECTS AND DISEASES

Direct Effects

- ***Direct Effects of No-Action Alternative A to Insects and Diseases***

Sawlog volume would continue to be lost from the project area due to insect and disease effects, especially from Douglas-fir bark beetles and Armillaria root disease, in inaccessible stands with large trees. Salvage logging would continue where stands are accessible without building roads.

If this alternative were implemented, seral and other shade-intolerant species, such as western larch and Douglas-fir, would continue to be lost from insect infestations and disease infections. The spread of the fir engraver would continue, causing mortality in grand and subalpine fir.

- ***Direct Effects of All Action Alternatives to Insects and Diseases***

Harvest treatments would target those species or individuals affected by insects and diseases, as well as the salvage of recently killed trees. Douglas-fir currently or recently infested by the Douglas-fir bark beetle would be removed when merchantable value exists. Western larch with the most severe infections of dwarf mistletoe would be harvested. Other species that would be discriminated against in harvests include grand fir and subalpine fir. By removing green infected trees, the continued spread of the various insects and diseases would be hampered.

Direct effects of the harvest treatments are the removal of trees affected by insects and diseases, those with reduced growth rates due to age, and shade-tolerant trees that do not help meet desired future conditions. Seedtrees, primarily western larch, would be left scattered throughout the harvest units to provide a seed source for natural regeneration.

Insect and disease problems would be reduced following implementation of any action alternative. Action Alternative B does the most to control rates of spread, economic value loss, and volume loss within the project area. The other action alternatives in order of decreasing efficacy in treating insect and disease activity would be Alternative D, C, and E.

- ***Direct Effects of Action Alternative B to Insect and Disease***

Units proposed for harvesting under this alternative are moderately to heavily affected by insect and disease activities. Treatments are focused on those stands with the greatest amounts of mortality and economic value loss. Treatments would remove merchantable dead timber, green timber affected by insects and diseases, those with reduced growth rates due to age, individual trees considered at risk of infection, and the less desirable shade-tolerant species that are more susceptible to insect and disease problems.

The majority of the units would be treated with regeneration harvests, but some commercial thinning would be applied. Regenerating species would be shade-intolerant species, such as western larch, that are more resistant to many of the infecting agents currently present. This alternative treats the most acres

(1,674) with insect and disease problems in the project area.

- ***Direct Effects of Action Alternative C to Insect and Disease***

  Many of the stands selected for this alternative have insect and disease activities occurring at elevated levels. Emphasis would be placed on trees (groups or individuals) that are affected by insects or diseases, are at risk of infection, or, if dead, contain merchantable material. In units utilizing a regeneration harvest, seedtrees would remain scattered throughout to provide a seed source; these seedtrees would primarily be shade-intolerant species, such as western larch, that have a higher tolerance to insects and diseases. Fewer acres receive regeneration harvests with this alternative, reducing the control of insect and disease problems, compared to Action Alternative B. This alternative treats 1,648 acres with insect and disease problems in the project area.

- ***Direct Effects of Action Alternative D to Insect and Disease***

  Harvesting is proposed in some stands with moderate to heavy levels of insect and disease problems, although approximately half the stands selected have low levels of insect and disease activity.

  Harvest treatments would focus on the removal of trees affected by insects and diseases, those with reduced growth rates due to age, and shade-tolerant trees that do not meet desired future conditions. The amount of regeneration harvesting would be intermediate between Action Alternatives B and C, with a corresponding intermediate effect on reducing insect and disease problems. This alternative treats 1,575 acres with insect and disease problems in the project area.

- ***Direct Effects of Action Alternative E to Insect and Disease***

  The stands proposed for harvesting have moderate to heavy insect and disease activities and are in the lower elevations of the project area. An objective for this alternative was to limit the amount of old-growth stands that would be harvested. In doing so, the stands most affected by insect and disease activities would be avoided. Areas of known beetle populations and other diseases would be left untreated, which would allow the continued spread of existing insect and disease problems.

  In the treated units, emphasis would be placed on the removal of trees affected by insects and diseases, those considered at high risk, and shade-tolerant species that do not meet desired future conditions. The avoidance of many stands with known insect and disease problems results in this alternative having the least effect on reducing insect and disease problems. This alternative treats 1,445 acres with insect and disease problems in the project area.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Insects and Diseases***

  School trusts may lose long-term revenue due to:

  - increasing mortality rates and sawlog defect that are caused by the ongoing presence of a variety of the aforementioned pathogens;

  - reduced gowth rates as old-groth stands continue to age and defects increase; and

- the nonregeneration of high valued species shuch as western larch and western white pine

- ***Indirect Effects of Action Alternatives B, C, D, and E to Insects and Diseases***

  Where shelterwood and commercial-thin treatments are applied, an indirect effect would be increased vigor and growth rates of the remaining trees due to the availability of light, nutrients, and moisture. Following treatment, the species composition would be more resilient to damage by forest diseases and insects.

  Rust-resistant western white pine, western larch, and, in some cases, ponderosa pine would be planted in units utilizing seedtree harvest treatments. The white pine seedlings would increase a declining component on Swan River State Forest. The planting of western larch would help reduce the likelihood of future insect and disease problems due to its lower susceptibility to many of the problems being addressed.

  Under Action Alternative B, the newly established stands would be healthier and the overstory would not be laden with insect and disease activities that would infect/infest the seedlings. This alternative would also treat the most acres with insect and disease problems, which, in turn, would lead to healthier forest stands for the future.

  Action Alternatives C and D also propose harvesting insect-infested and disease-infected stands. These alternatives would not treat as many acres as Action Alternative B, but would have similar effects on the acres that were treated. Overall, these alternatives would do less than Action Alternative B to address the insect and disease problems prevalent in the project area.

  Action Alternative E would do the least to address insect and disease problems in the project area. Treatments in stands currently affected by insect and disease problems would provide benefits to the newly developed stands. Treated stands that do not have current problems may be more resistant to future insect and disease activities. However, the avoidance of known insect and disease hotspots would provide a dissemination source, which would increase the future spread of insect and disease problems, when compared to the other alternatives.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Insects and Diseases***

  No harvesting of live, dead, dying, or high-risk trees would occur. Some salvage harvesting of insect-infested and disease-infected trees would occur, but at a slower, less effective rate, and not as a result of this analysis or association with this project. Forest stands would maintain dense stocking levels, which contribute to the spread of insects, diseases, and fuel loading, which could lead to high-intensity fires, unnatural forest structures, and overall poor health of the stand. Current forest conditions would continue.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Insects and Diseases***

  Timber-management activities on Swan River State Forest have generally implemented prescriptions that would reduce losses and recover mortality due to stem rots, bark beetles, white pine blister rust, western larch dwarf mistletoe, blowdown, and other causes. Stand-regeneration treatments are producing stands with species compositions more resilient to the impacts of forest insects and diseases and more in

line with historic forest conditions. Thinning treatments have further reduced the percentage of infected or infested trees.

The cumulative effects of these treatments are shown in *FIGURES C-7 (8, 9, 10) - AGE CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B (C, D, E)* under *AGE CLASS DISTRIBUTION*, where the increase in the 0-to-39-year age class is a result of silvicultural treatments. Older trees are the most susceptible to many of the identified insect and disease problems in the project area.

FIRE EFFECTS

SWAN RIVER STATE FOREST HISTORY

The fire regime across Swan River State Forest is variable. The forest displays a mosaic pattern of age classes and covertypes that have developed due to variations in fire frequency and intensity. In areas that have experienced relatively frequent fires, Douglas-fir, western larch, and ponderosa pine covertypes, with a component of lodgepole pine and western white pine, were produced. As fire frequencies become longer in time, shade-tolerant species (grand fir, subalpine fir, Engelmann spruce, western hemlock, western red cedar) have a better chance to develop. Higher elevation sites within the forest have longer fire frequencies, and the resultant stands are multistoried with a dominant shade-tolerant covertype. Where fire frequencies were short, the stands are open and single storied, occasionally two storied. As fire suppression began, covertypes and fire frequencies were altered. Stands of ponderosa pine, western larch, and/or Douglas-fir have become multistoried with shade-tolerant species. Ponderosa-pine-dominated stands that were once open now have a thick understory of Douglas-fir. Fires that do occur are generally kept small and natural fire effects are limited. If a larger scale fire were to start, many acres could be affected due to ladder fuels, heavy fuel accumulation, and other environmental factors.

Swan River State Forest has identified 67 fires over the last 25 years. Over the last 25 years, 48 lightning fires have burned 98.5 acres, with the largest occurring in 1994 during a dry lightning storm; that fire burned 65 acres in the upper subalpine fir habitat types. Lightning causes approximately 72 percent of all fire starts on Swan River State Forest. On average, 2.68 fires per year occur; approximately 2 are from natural events and 1 is human-caused. Human-caused fires are typically started from campfires, debris burning, or incidents directly related to powerline sparks. Within the project area, an average of 1 fire per year occurs and is usually caused by lightning. (*Personal communication Allen Branine, 2006.*)

Past research has been conducted that looked at fire history within the Swan Valley. The following summaries describe the fire history and the patterns they created on the landscape.

Hart (1989) summarized the historical data as follows:

> *Although most of the burns…were of stand-replacement intensity, many less intense fires had also crept over wide areas. The upper (southern) half of the Swan valley had been extensively burned, and was blanketed by fallen trees. In this area, fires were moderate, thinning the forest. The lower (northern) Swan also was scarred by fires, but it had a great deal of older mixed forest; species typical of*

mesic sites were found in this region….

Antos and Habeck (1981), working mostly in the northern portion of the Swan Valley, emphasized the dominance of low-frequency, high-intensity fires (stand-replacement fires) in determining stand patterns:

> *During most summers, the occurrence of frequent rain makes intense fires unlikely; but in some years, dry summers set the stage for large crown fires. Most stands were initiated on large burns…. An average frequency of replacement burns of between 100 and 200 years was characteristic…. Stands over 300 years old do occur, and repeat burns less than 20 years apart have also occurred. In some forests initiated by replacement burns, ground fires have occurred after stand establishment, with variable effects on the overstory. Very wet sites, such as stream bottoms and lower north slopes, often experience partial burns when located within the perimeter of large replacement burns.*

The analysis of fire history indicates that the lower elevations of Swan Valley were burned frequently; in the drier southern half, the intervals were shorter than on the more moist northern part. Between 1758 and 1905, this portion of the range had fire-free intervals of about 30 years, and the presence of western larch and even-aged lodgepole pine suggests the fires were of higher intensity. The remaining samples are from the southern end and these have a shorter interval of 17 years (*Freedman and Habeck, 1984*).

Historical data indicates that forests in Swan River State Forest and the project area were cooler and moister than the broad scale Climatic Section and western Montana averages. They were also considerably older with a far higher proportion of western larch/Douglas-fir covertypes than at the broad scale. Although the forests of Swan River State Forest were old, the representation of shade-tolerant covertypes was low, indicating disturbance was frequent or recent enough to prevent widespread covertype conversion through succession.

FIRE GROUPS

The Three Creeks Timber Sale Project area is primarily represented by 2 different fire regimes that are classified as fire groups: Fire Group 11 and Fire Group 9 (*Fischer and Bradley, 1987*). Five other fire groups are within the project area, but due to minor representation (5 percent or less), these fire groups will not be addressed further in this document. The project file at the Swan River State Forest office contains information on the other fire groups.

Fires burned in the project area at intervals of 15 to 200-plus years. The various fire intervals and intensities created a mosaic of stands in the forest across the project area. Management in the project area is attempting to mimic, at least in part, historic fire patterns and intensities. The species representation in the project area has also been influenced by fire disturbances. Where feasible, in terms of covertypes (western larch/Douglas-fir, western white pine, etc.), treatments would attempt to move the forest toward desired future conditions and maintain these covertypes by future management activities (*FIGURE C-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST* and *FIGURE C-2 - CURRENT COVERTYPE*

PROPORTIONS FOR SWAN RIVER STATE FOREST).

The Three Creeks Timber Sale Project area is primarily represented by Fire Group 11 (62 percent of the project area), Fire Group 9 (25 percent) being the next most common, and minor representation in Fire Groups 10 (5 percent), 7 (4 percent), 6 (3 percent), 8 (2 percent), and 5 (less than 1 percent) (*Fischer and Bradley, 1987*).

The majority of the proposed stands fall into Fire Group 11, which represents a warm, moist, grand fir habitat type where fires are infrequent but severe, and the effects are typically stand replacing. Fire-free intervals range from 100 to 200 years between stand-replacing fires. This fire group has predominately moist conditions, which can allow these areas to serve as a fire break for low-intensity ground fires. The sites are also known to have high fuel loadings, high plant productivity, and, when combined with drought conditions, these lead to severe and widespread fires.

The next common fire regime in the project area is Fire Group 9, which is characterized by moist, lower subalpine habitat types where fires are infrequent, but severe, and the effects may be long lasting. Past studies show an average fire-free interval of 30 years, with extremes of 10 to 100 years. The dominant representation of ponderosa pine, western larch, and Douglas-fir reflects the relatively high fire frequency. Due to the moisture content of these stands, moderate to severe fires may have been restricted to brief periods in the summer. Flare-ups may have caused openings that allowed the establishment of seral species.

The other 5 fire groups identified in the project area are represented in lesser amounts. Fire group 10 is a cold, moist, upper subalpine fir type where fire plays a secondary role to site factors. The main influencing factors in this habitat type are climate and soils, which influence forest development on these sites. Fires are infrequent, with a range of 35 to 300 years. More pronounced effects of fire frequency are when stand-replacing fires occur at 200 years or more.

Fire Group 6 is a moist Douglas-fir habitat type. Prior to European settlement, this group was a fire-maintained open forest. A typical fire interval ranged from 15 to 40 years, which maintained an open forest and kept brush at low levels. The frequent fires would favor western larch and ponderosa pine over Douglas-fir.

Fire Group 7 is a cool type often associated with forests dominated by lodgepole pine. Periodic disturbances, from low-intensity to stand-replacement fires, are common to these stands. Stand-replacement fires generally occur in 50- to 100-year cycles, but may extend to 500 years in some cases. Typically by 60 to 80 years, the stand is in a condition where an ignition source may generate a stand-replacing fire.

Fire Group 8 is a dry, lower subalpine habitat type. This group falls between Group 7 with a burn cycle of 50 years and Group 9 with a fire frequency of 90 to 130 years. Periodic low- to moderate-severity fires favored Douglas-fir and lodgepole pine and held back shade-tolerant species like subalpine fir and Engelmann spruce.

Fire Group 5 is a dry Douglas-fir site and occupies less than 1 percent of the project area. This group has short fire intervals of 35 to 45 years. These short fire intervals are typical of open forests that generate park-like stands.

HAZARDS AND RISKS IN THE PROJECT AREA

The hazards and risks associated with wildfires include a potential loss of timber resources, effects to watersheds, and loss of property. The majority of timber stands being considered for harvesting are in the mature or older age classes in stands that have not burned since pre-European settlement. Fire hazards in these areas range from above- to near-natural levels with moderate to high accumulations of down and ladder fuels relative to stand densities. Some of the western larch/Douglas-fir stands have a dense understory of grand fir, a significant hazard due to its density and structure and the increased risk that a low-intensity ground fire could develop into a stand-replacing crown fire.

Many of the old-growth stands in the project area are relict stands. Stand-replacing fires have not occurred in the area for 200 or more years. As the stands continue to age and mortality occurs from various biotic and abiotic factors, fuels would accumulate. These stands have an in-growth of shade-tolerant trees, which provide ground and ladder fuels, thus increasing their susceptibility to intense fires, especially during drought. Accessible stands have had salvage logging and firewood cutting that has reduced the larger diameter down fuels in the area. The continued encroachment of shade-tolerant trees, accumulations of down woody debris, and mortality increases the fire risks.

Increased recreational use in the area is another potential ignition source that may result in a hazardous condition due to fuel accumulation.

Nonindustrial forestland adjacent to the project area has a similar amount of fuel loading. Much of the adjacent USFS ownership has not been managed for several years. The resulting stands have a moderate to high risk of stand-replacement wildfires due to continued heavy fuel loadings.

ALTERNATIVE EFFECTS TO FIRE EFFECTS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Fire Effects***

  The wildfire hazard would not change substantially in the short term. With continued fuel accumulation from down woody debris, the potential for wildfires increases. Large-scale, stand-replacing fires may be the outcome.

- ***Direct Effects of Action Alternatives B, C, D, and E to Fire Effects***

  Immediately following timber harvesting, the amount of fine fuels would increase. Hazards would be reduced by scattering slash, cutting limbs and tops to within a maximum height to hasten decomposition, spot-piling by machine in openings created by harvesting, and burning landing piles.

  Broadcast burning would be utilized as a site-preparation method in some seedtree units, while others would be treated by simultaneously piling slash and scarifying soil with an excavator, followed by the burning of piles. Scarification and broadcast burning both prepare seedbeds for natural regeneration. Broadcast burning would consume fuels and return nutrients to the soil at a faster rate than unburned areas.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Fire Effects***

  Eventually, due to the continuing accumulation of fine fuels, snags, ladder fuels, and deadwood components, the risk of stand-replacement fires would increase.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Fire Effects***

  The hazards of destructive wildfires in these stands would be reduced because larger, more fire-resistant species would be left at wider spacings. Grand fir, some Douglas-fir, western red-cedar, and subalpine fir, which pose a higher crown-fire hazard because of their low-growing branches and combustible nature, would be removed. This would reduce the potential mortality from low- to moderate-intensity fires, but would not “fireproof” the stands from the high-intensity stand-replacing fires brought on by drought and wind.

  Seedtree and shelterwood harvest treatments would cause wildfire hazards to be reduced. Regeneration harvests, where slash has been treated but trees are still small, have proven to be fire resistant in many cases. However, contrary conclusions have been put forth wherein timber harvesting is believed to have increased the risk of wildfires, especially in the short term, where logging slash was not treated. Fire hazards would slowly increase over time as trees reach pole size, crown densities increase, and fuels accumulate.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Fire Effects***

  The risk of wildfires would continue to increase as a result of long-term fire suppression.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Fire Effects***

  Fuel loadings would be reduced in treated stands, decreasing wildfire risks in these specific areas.

  The Goat Squeezer II and III timber sales have a combination of broadcast burning and excavator piling and burning to be completed this fall and the following spring. Ongoing salvage sales across Swan River State Forest will also have excavator piling and burning associated with slash at the landings. The net cumulative effect would be a reduction in wildfire risks.

OLD GROWTH

DNRC defines old growth as stands that meet minimum criteria for number, size, and age of trees per acre for a given combination of covertype and habitat-type group. The definitions are adopted from those presented by *Green et al., (1992)*. DNRC’s definition has evolved over the years; previous analysis may appear to contradict the analysis presented in this FEIS because of that evolution. The multitude of diverse old-growth definitions used by various researchers, organizations, and individuals tends to further confuse the discussion of old growth, so we attempt to clarify the basis for the source of the old-growth information we present.

HISTORIC ESTIMATES OF OLD GROWTH

Many previous efforts have been made to estimate the historical amounts of old growth in Swan valley. The following approaches have been used:

- DNRC estimated the quantity of old growth that may have existed historically (*Montana DNRC 2000*); results suggested that, given the definition used in the analysis, approximately 22 percent of Swan River State Forest represents the expected amount of naturally occurring old growth. That analysis used a more restrictive definition for old growth than DNRC currently uses.
- *The Flathead National Forest (FNF) Plan Amendment 21 (1998)* estimated that 29 percent of low-elevation forests on FNF was old growth, 8 percent of mid-elevation forest

was old growth and none of the high-elevation forest was old growth, as derived from historic surveys (*Ayers 1898, 1899*). Using various sources of information, the *FNF Amendment 21* also estimated that old growth in FNF had an historical range of variability from 15 to 60 percent. Using a computer modeling process, FNF estimated that approximately 36 percent of the Swan valley existed as late-seral forest; however, not all late-seral stands would qualify as old growth.

- *Lesica (1996)*, in an effort to use fire history to estimate the proportions of old-growth forests in Swan valley, estimated that approximately 52 percent of the area was occupied by stands that were 180-years or older. *Lesica* used stand age as a surrogate for old growth in his mathematically derived estimations.
- Using covertype conditions and historical data from the 1930s (*Losensky 1997*), 29 percent of the forested acres in the Upper Flathead Climatic Section were estimated to have historically been occupied by stands 150 years and older and contained a minimum of 4 mbf/acre (*SOUTH FORK LOST CREEK FEIS, 1998*). The old-stand definition from *Losensky* was previously used as DNRC's old-growth definition, adding to the confusion over old-growth reporting and discussion.
- *Hart (1989)* indicated that approximately 48 percent of the area represented in the 1930s stand data for the Seeley and Swan valleys had forests with a significant component of trees older than 200 years.

Therefore, using a wide variety of old-growth definitions, the estimates of the historic amount of old growth on Swan River State Forest suggest a range from 15 to 50 percent. The estimates above are primarily age-based estimates that do not consider the other attributes often deemed necessary to call a stand "old growth", and, therefore, old-growth amounts are overestimated compared to when it is defined with additional attribute thresholds; for example, only DNRC's estimate has any criteria related to the size and number of large trees per acre, leading one to the conclusion that old growth would necessarily be lower than the other estimates provided because not all old stands, late-seral stands, or modeled stands would have sufficient numbers of large live trees to meet DNRC's old-growth definition.

Emphasis should be made that the estimates presented defined old growth in a variety of ways and none of them represent estimates based on the *Green et al* definitions that DNRC currently uses; most provide estimates that are higher than they would be if they included additional attribute criteria.

Based on available estimates, the amount of old growth on Swan River State Forest is currently within the historically occurring range.

ANALYSIS METHODS

DNRC uses criteria set forth in *Green et al. (1992)* to define old growth. The definition sets minimum thresholds for the number and size of large trees based on habitat type and covertype. The SLI data categorizes many stands within the project area as old growth. As part of the field reconnaissance for this project, stands identified as old growth via the SLI data, or those in question, were field-checked to verify that they meet DNRC's definition.

EXISTING OLD-GROWTH DISTIBUTION

Swan River State Forest currently has 12,478 acres of old growth, which is equal to 32.4 percent of the total acreage. The project area contains 4,483 acres of old growth,

which is equal to 42.2 percent of the project area. Old-growth acreages may change as field surveys are completed and the SLI database is updated. *TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST* shows the amount of acres in old-growth status per covertype according to the current SLI database information. The current analysis also looks at the old-growth spatial distribution to analyze the effects of a proposed action.

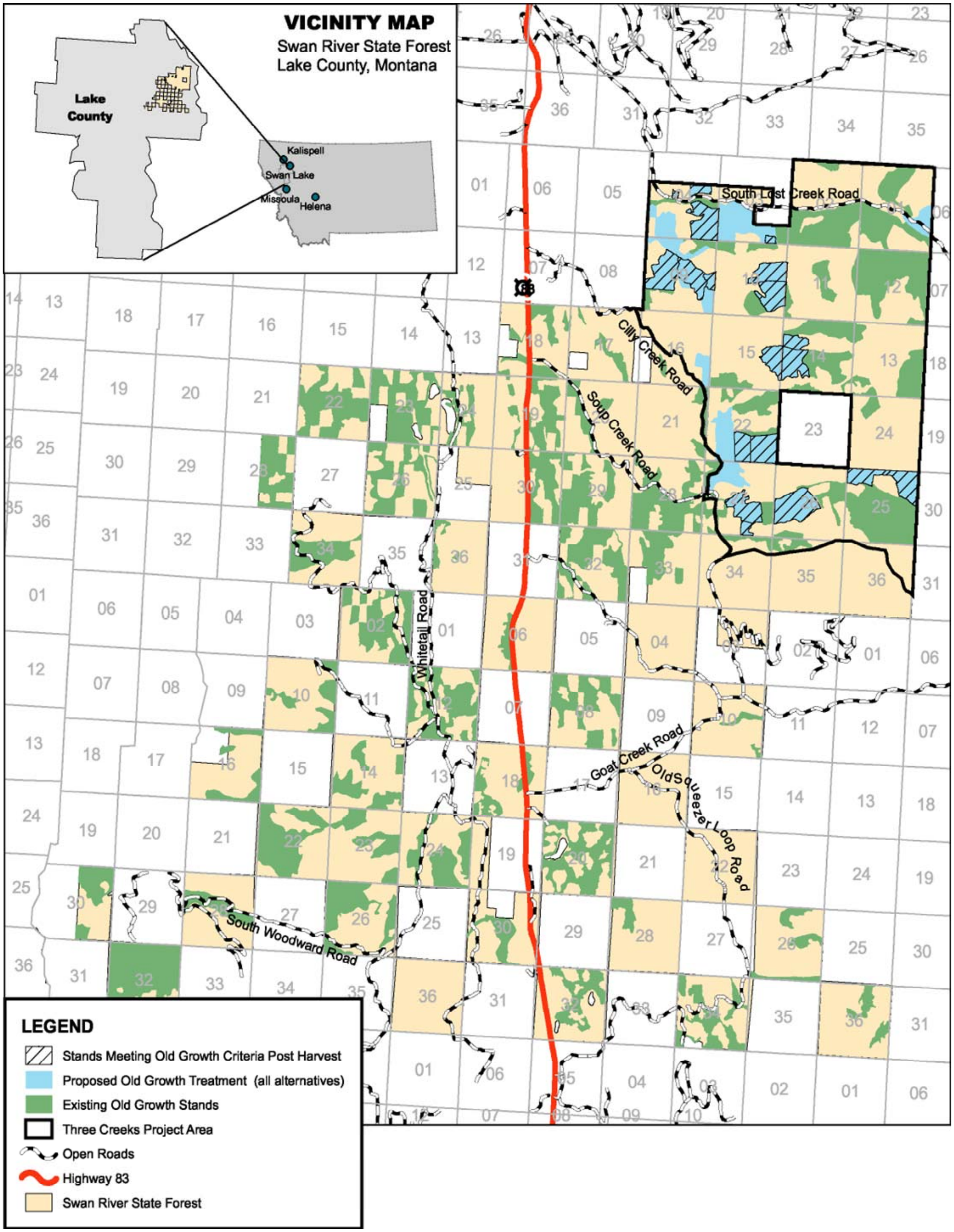
TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST presents total acres of old growth by forest type. Covertypes reflect the interactions of disturbance history, species requirements for regeneration, physiography, and availability of a seed source. The old-growth definitions used by DNRC are expressed in terms of covertype, thus allowing comparisons to *Losensky's (1997)* historic information for amounts of old-age stands. Mixed conifer, western larch/Douglas-fir, and western white pine (*TABLE C-3 - CURRENT AND POSTHARVEST STAND STRUCTURE OF UNITS PROPOSED FOR HARVEST IN THE THREE CREEKS PROJECT AREA*) are currently the 3 dominant old-growth types on Swan River State Forest. The increase in acres of specific old-growth types shown in *TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST* occurs as a result of commercial-thin and shelterwood treatments, where sufficient large live trees are retained to meet DNRC's old-growth definition, but removal of certain species of trees results in a reclassification of the "type" of old growth.

FIGURE C-12 - CURRENT OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST is a map of old growth within the project area. In addition to old-growth stands identified by the SLI in the project area, approximately 992 acres of old growth have been field verified.

TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST

OLD-GROWTH TYPE	OLD-GROWTH ACRES	POSTHARVEST ACTION ALTERNATIVE			
		B	C	D	E
Douglas-fir	8	8	8	8	8
Western larch/Douglas-fir	1,830	1,893	1,894	1,960	1,710
Western white pine	2,016	2,016	2,016	2,016	2,016
Mixed conifer	6,926	6,299	6,396	6,200	6,699
Subalpine fir	1,114	1,114	1,114	1,114	1,114
Lodgepole pine	0	0	0	0	0
Ponderosa pine	584	584	584	584	584
Totals	12,478	11,914	12,012	11,882	12,131

FIGURE C-12 - CURRENT OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST



OLD-GROWTH ATTRIBUTES

The diversity of old-growth definitions and the relative importance of old growth as a specific stand condition led DNRC to develop a tool to analyze and understand old growth. This tool indexes attribute levels in stands using DNRC's SLI and is called the Full Old Growth Index (FOGI).

The old-growth attributes making up FOGI are:

- number of large live trees,
- amount of coarse woody debris,
- number of snags,
- amount of decadence,
- multistoried structures,
- gross volume, and
- crown density.

Old-growth "quality" was raised as an issue. Old-growth quality depends on the type of old growth, associated wildlife species being considered, where old growth exists on the landscape, and other factors that do not lend themselves to consistent or meaningful quantification. For the purposes of this analysis, we are using attribute levels (FOGI) as an indicator of quality, but are also cognizant that quality is too nebulous a concept for a quantitative analysis. Using FOGI provides an indication of the relative levels of "old growthedness". FOGI could be construed as providing an indication of old-growth "quality", but is more appropriately considered an indication of overall attribute levels. So, while the highest attribute levels may be high quality for some wildlife species and old-growth types (for example mixed-conifer old growth, which tends to exist in a dense and structurally diverse condition), other species and types are highest quality at relatively lower attribute levels, in particular the ponderosa pine type (which tends to exist in a more-open condition that is less structurally diverse). Therefore, the analysis focuses on quantitative or qualitative assessment of attribute levels rather than relying on the value-laden concept of "quality".

Indicators of Old-Growth Attributes

We recognize that our desired management strategy under the SFLMP is to retain, in reasonable proportions, stands that contain all the naturally occurring combinations of attributes, including those associated with old-growth stands. Thus, in this section, we display current conditions with regard to attributes often associated with old growth. The attributes displayed are numbers of large live trees, amount of coarse woody debris, snags, vigor, stand structure, and gross volume per acre.

Lacking are surveys specifically oriented to clearly identify all stand characteristics that would characterize old growth. However, indices were derived from data in our SLI that summarized the abundance of 4 attributes that often, but not always, characterize stands in the latter stages of development: large live trees, snags, down coarse woody debris, and decadence among live trees. In each case, a standard step-by-step procedure was used that integrated information from more than 1 field in the SLI to produce a single index number (*TABLE C-10 - OLD-GROWTH INDEX ATTRIBUTES AND POINT ASSIGNMENTS*). Briefly, the "large tree" index measures the relative abundance of trees more than 21 inches dbh. The snag index measures the relative abundance of large dead trees, with greater weight given to larger-diameter snags, but equal weight given to snags by their species and other characteristics. Similarly, the index of down coarse woody debris measures the relative abundance of down woody material, with greater weight given to the logs of larger diameter, regardless

TABLE C-10 - OLD GROWTH INDEX ATTRIBUTES AND POING ASSIGNMENTS (BLANK SPACES ARE NOT APPLICABLE. SEE ATTACHMENT C-1 FOR ATTRIBUTE ASSIGNMENTS)

ATTRIBUTES	0	1	2	3	4	5	6	7
Number of large trees	None		Few		Some		Lots	
Coarse woody debris	None	Few	Some	Lots				
Number of snags	None	Few	Some	Lots				
Decadence	None	Little	Some	Lots				
Structure	Single	2-storied	Multi-storied					
Gross Mbf	Less than 4	4-6	7-9	10-12	13-15	16-20	21-25	26+
Crown density index	Poor 9 to 39%		Medium 40 to 69%		Well 70%+			

of species or degree of rot. Vigor of old-growth stands is discussed as a surrogate for stand decadence. Stands with higher vigor ratings are those with lower decadence and vice versa.

In each case, only 4 categories of abundance were used, which corresponded roughly to the 4 adjectives:

- none
- few (or little)
- some (i.e., a typical amount for a stand of that forest type and age, neither particularly few nor many)
- many (or much)

This description is necessarily crude; we cannot describe existing conditions or model future effects with greater resolution than our current inventory allows. However, our understanding of the naturally occurring abundances and dynamics of these old-growth attributes is similarly crude. Thus, even if a more precise description or assessment were possible, we are unsure the additional resolution would be informative. We believe, moreover, that despite their inevitable approximations, these descriptions and assessments are generally accurate and objective and serve as useful proxies to guide our more general evaluation of diverse forest types and structures.

The FOGI process assigns an index rating to each old-growth attribute that, when summed, indicates its total score, or old-growth index, for the stand. For analysis purposes, these scores can be grouped into low, medium, and high categories. This provides an indication of the condition of the stand in regards to attributes often associated with old growth. These indices do not necessarily indicate old-growth quality, but can be used to compare and classify a collection of older stands across the landscape. The expected variation between covertypes is based on numerous factors, including habitat-type groups, tree species, covertypes, elevations, past management activities, and proximity to roads. Many of these attributes relate to wildlife habitat and are discussed in *APPENDIX F – WILDLIFE ANALYSIS* of this FEIS. *TABLE C-11 - FOGI CLASSIFICATION FOR THE PROJECT AREA AND POSTHARVEST AMOUNTS* shows the current amounts of old-growth acres in each of the FOGI classifications and effects of the action alternatives.

STAND STRUCTURE OF OLD GROWTH

The structure of forested stands indicates one characteristic often associated with “old growth”, namely

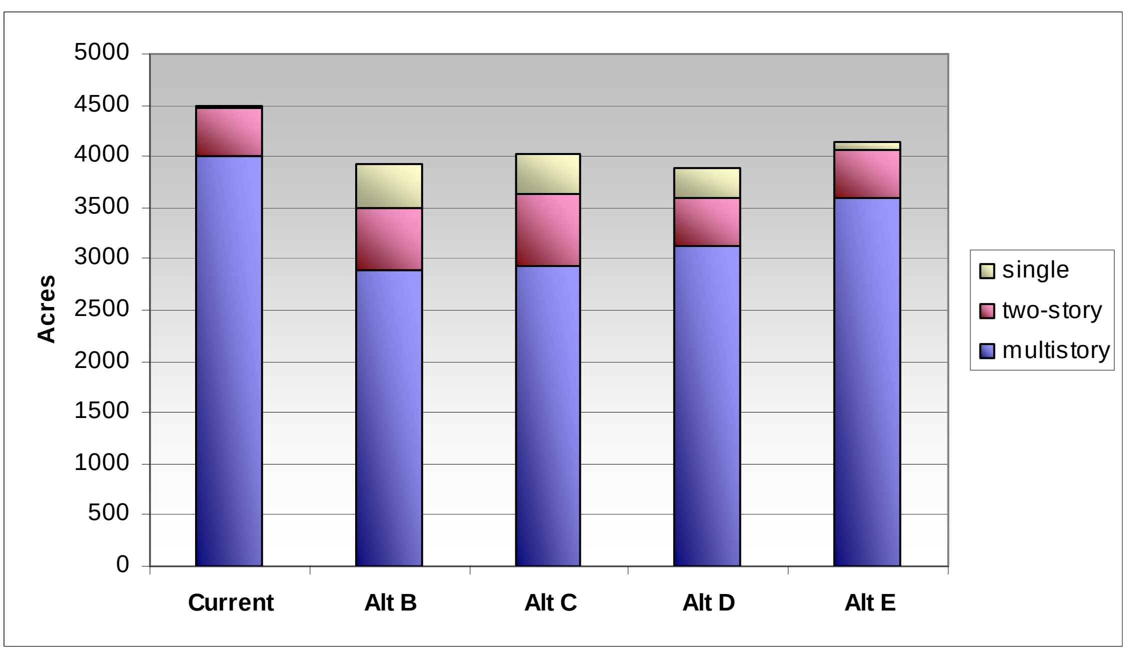
TABLE C-11 - FOGI CLASSIFICATION FOR THE PROJECT AREA AND POSTHARVEST AMOUNTS

FOGI CLASSIFICATION	CURRENT ACRES	ACTION ALTERNATIVE			
		B	C	D	E
Low	68	722	719	615	167
Medium	1,352	1,149	1,076	1,023	1,318
High	3,063	2,049	2,222	2,249	2,652
Totals	4,483	3,920	4,017	3,887	4,137

whether or not the stand is in a multistoried condition. The multistoried condition arises when a stand has progressed through succession to the point that shade-tolerant species are replacing a shade-intolerant overstory. This condition can also occur when a stand is already dominated by large, old, shade-tolerant species, and through gap replacement the regeneration that occurs is also shade tolerant. The former is the more common case in forests of Montana. In both cases, the time since a major disturbance tends to be long, helping to create many of the attributes important in old growth.

FIGURE C-13 - CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS IN THE PROJECT AREA displays the current conditions for stand structure of old growth and the postharvest effects of each action alternative. As shown, the vast majority of old-growth stands have multiple canopy levels. This figure also shows the postharvest distribution of stands for those that would retain old-growth classification. Many of the treatments are regeneration-type harvests, which completely change the stand structures and remove the stands from old-growth classification. Following regeneration harvesting, there would only be one distinct canopy level. For stands that receive a partial treatment, two or more distinct

FIGURE C-13 - CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS IN THE PROJECT AREA



canopy layers would remain. *FIGURE C-13 - CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS IN THE PROJECT AREA* illustrates the slight changes in structure from multistoried stands to single- or two-storied stands. Also reflected in the figure is the removal of stands that no longer meet the old-growth definition.

STAND VIGOR OF OLD GROWTH

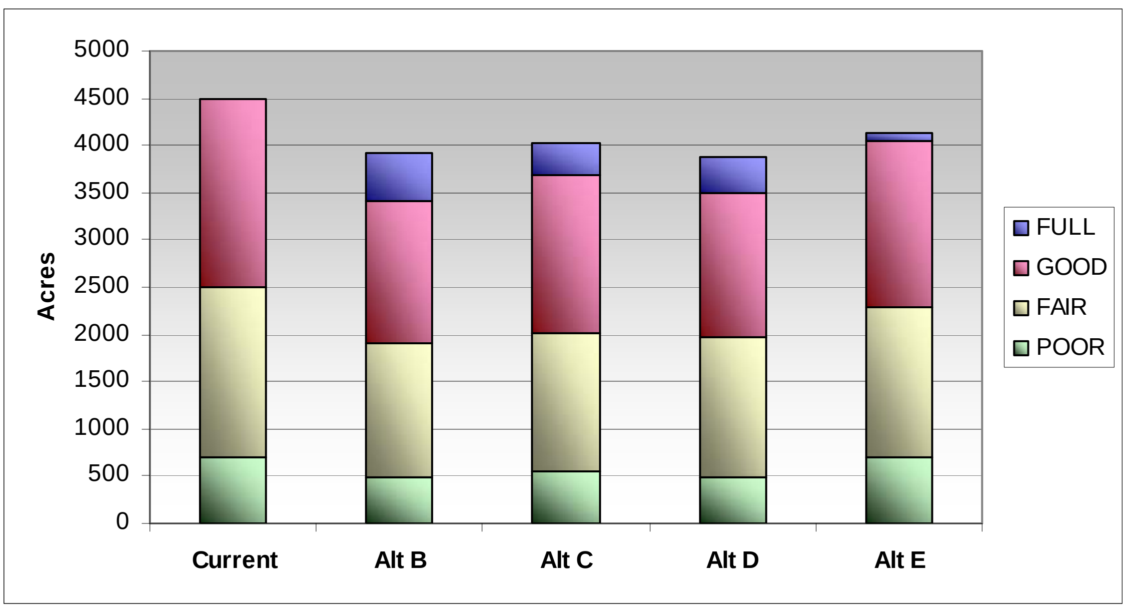
Vigor of old-growth stands is used to indicate relative decadence. Old-growth stands of low vigor are more likely to have more snags and greater amounts of large down woody debris than would be expected with stands of high vigor. Stand vigor is explained further below. *FIGURE C-14 - CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS IN THE PROJECT AREA* shows the vigor classes, by percentage for old-growth stands. As would be expected, no old-growth stands are at full vigor. Most stands are in the fair to poor class.

This figure also illustrates the changes that would take place following harvest prescriptions. The changes are subtle, but stands with full vigor would be increased. The treated stands would have reduced density and a more-open canopy, which would allow more light in and free up nutrients in the soil for the remaining trees to utilize. Stands would shift from the fair or poor vigor to the good or full vigor classification.

The 4 generally recognized vigor classes are: full, good-to-fair, fair-to-poor, and very poor.

- *Vigor 1 - Full Vigor* – Forests have an open canopy and growth is optimal. An example of a stand in this class is young, immature, and probably in the seedling or sapling stage. Currently, no acres of old growth within the project area are at full vigor.
- *Vigor 2 - Good Vigor* – Stand canopies are mostly closed with crown ratios (the vertical height of a tree’s crown compared with the total vertical height of the tree) between 33 and 50 percent. Growth rates exceed mortality in these stands. A stand in this

FIGURE C-14 - CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS IN THE PROJECT AREA



class would be young, merchantable sawtimber. Old-growth stands of good vigor represent 1,979 acres in the project area.

- *Vigor 3 - Fair Vigor* – Stand canopies are tightly closed with crown ratios less than 33 percent. Growth and mortality rates are nearly balanced. An example of a stand in this class would be an old stand of merchantable sawtimber. Old-growth stands of fair vigor occupy 1,799 acres in the project area.
- *Vigor 4 - Poor Vigor* – Stands are similar to the fair-to-poor class, but generally are in a decadent condition caused by competing vegetation, insects, diseases, and/or old age. Typically, mortality rates exceed growth rates. Old-growth stands of poor vigor occupy 705 acres in the project area; all are at risk to insects and diseases.

LARGE TREES PER ACRE

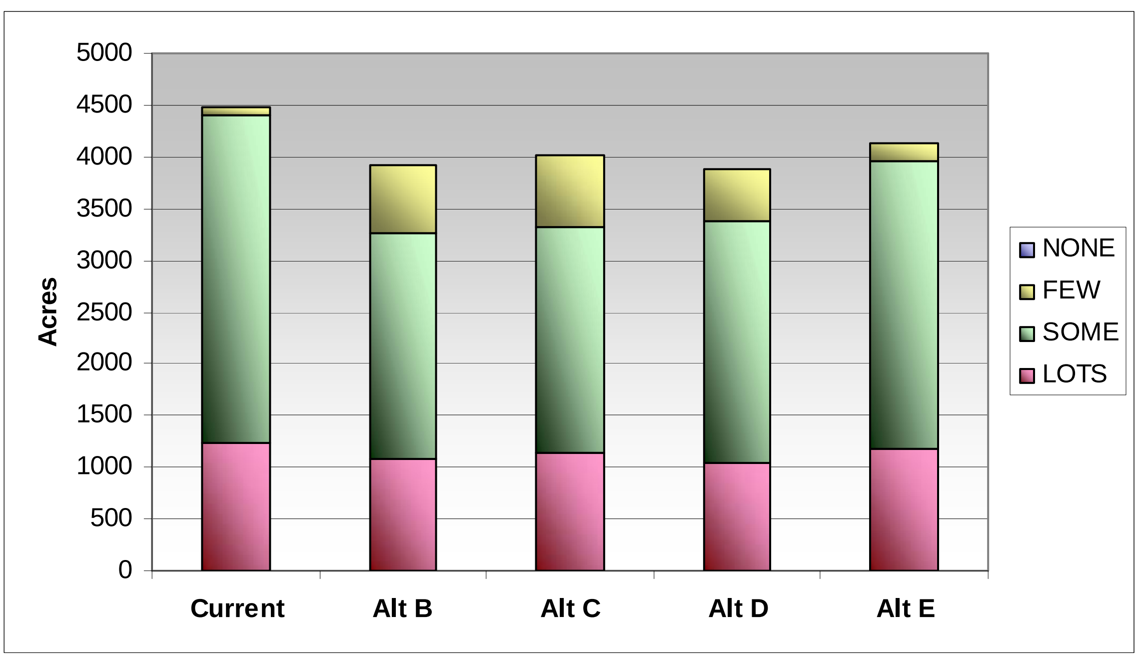
FIGURE C-15 - CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA shows the relative abundance of large trees in old-growth stands. As shown, approximately 28 percent of all old-growth stands are within the highest abundance category for numbers of large live trees, with 71 percent having 'SOME' the next highest amount.

This figure also shows the subtle changes in the percent of stands with large trees on a per-acre basis. Some stands would no longer meet the old-growth definition and are not included, but for those that are included, the change is very slight. Action Alternative E retains the highest proportions of large trees in the "SOME" and "LOTS" categories, while the other alternatives show greater reductions in the numbers of large live trees.

SNAGS PER ACRE

FIGURE C-16 - CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA shows the relative abundance of large snags in old-growth stands. The preponderance of

FIGURE C-15 - CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA



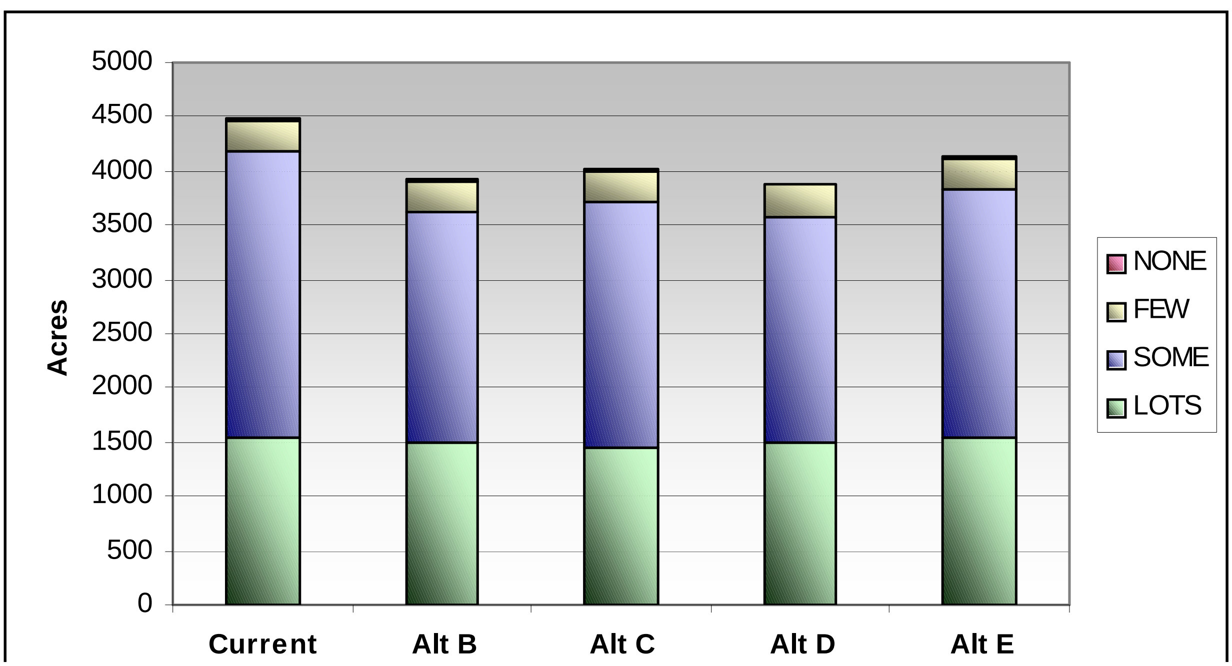
stands has some or lots of large snags. The 'FEW' category represents DNRC's minimum for snag retention postharvest. The amount of snags fluctuates across the landscape due to salvage harvesting, which reduces the numbers and continued mortality from insect and disease activities, which increases snag amounts. This figure also illustrates the postharvest levels of snags per acre. The change in the percentage of stands with the minimum requirements for retention is minor. Over 99 percent of old-growth stands would still have 2 snags or better per acre. Based on estimates of historical snag numbers (*APPENDIX F—WILDLIFE ANALYSIS*), postharvest snag levels well exceed average historical conditions with over double the expected amount of large snags.

AMOUNTS OF COARSE WOODY DEBRIS

Coarse woody debris is measured by the number of pieces present along transect lines through a stand. The pieces are measured for diameter and grouped in ranges such as 6 to 10, 11 to 15, 16 to 20, and so on. The volume or tons per acre of coarse woody debris is also recorded. The SLI database contains information on coarse woody debris primarily for older stands on Swan River State Forest. The older stands (100+ years) show various quantities and sizes of coarse woody debris. Stands with the most pieces and the greatest tons per acre are between 150 to 200 years old, but are not necessarily old growth. For the project area, the maximum tons per acre are 155, the minimum is 0, and the average for the project area is 42 tons per acre. Stand data information describing the number of pieces per grouped range, number of small pieces, number of large pieces, level of decay, and tons per acre is available in the project file.

FIGURE C-17 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS WITHIN THE PROJECT AREA shows the relative abundance of down coarse woody debris in old-growth stands. As with the snag numbers, salvage

FIGURE C-16 - CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS IN THE PROJECT AREA



operations are expected to reduce the amount of coarse woody debris in old-growth stands across Swan River State Forest, resulting in a preponderance of stands in the "SOME" and "FEW" categories.

This figure also shows that following harvesting operations, the coarse woody debris remaining would increase, primarily due to slash generated during harvesting. Some stands may not have the finer materials, but the larger-diameter woody debris would be retained.

GROSS VOLUME PER ACRE

Another attribute of old-growth stands often deemed important and for which distributions can be quantified and effects assessed is a measure of density, or stocking. In this case, the stand's gross board-foot volume per acre is used (*FIGURE C-18 - POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS IN THE PROJECT AREA*). Higher volumes indicate more densely stocked stands. One value of this measure is that effects of in-growth and lack of wildfires are minimized because only trees larger than 9 inches dbh are included. Thus, this becomes another measure through which impacts on the character of old-growth stands can be measured.

As shown, a very small proportion (about 2 percent) of old growth stands in the project area contains less than 10 Mbf per acre. Approximately 46 percent of old growth stands contains over 25 mbf per acre. The majority of old-growth stands (78 percent) have 21 mbf or more per acre.

FIGURE C – 18 also illustrates the affects to gross volume per acre following harvesting operations. Old growth stands with less than 10 mbf per acre would vary from 4 to 13 percent. Stands that have more than 25 mbf per acre would decline slightly to a range of 30 to 42 percent, depending on the alternative. The majority of the stands would still have 21 mbf or more per acre, but would decline to a range of 61 to 68 percent; the exception would be those harvested under Action Alternative E, where

FIGURE C-17 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS WITHIN THE PROJECT AREA

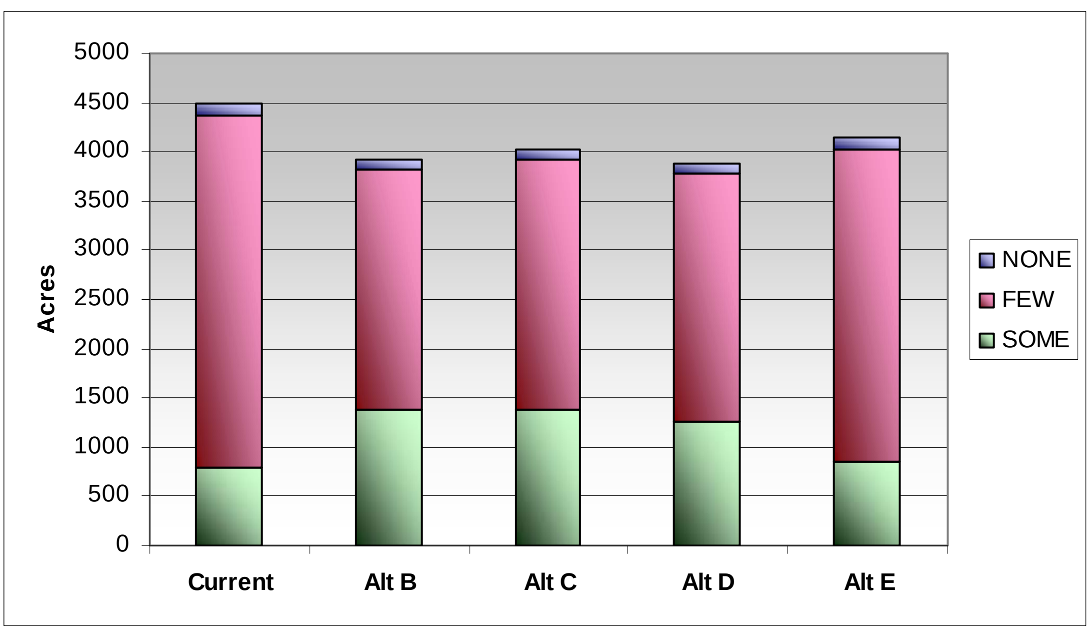
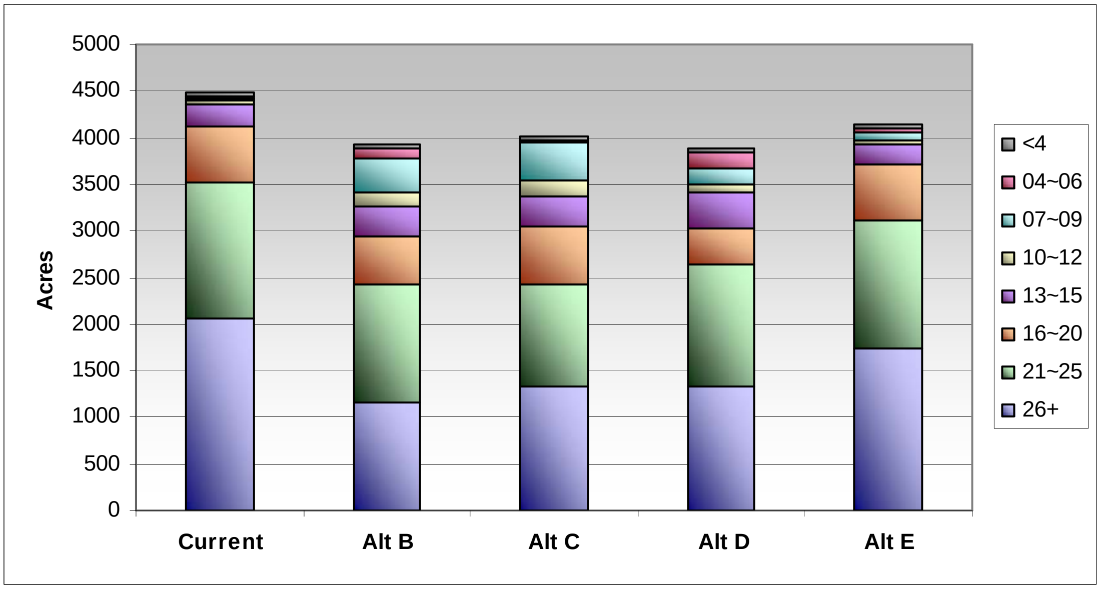


FIGURE C-18 - POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS IN THE PROJECT AREA



the percentage of stands would drop slightly to 75.

PREVIOUS TREATMENTS IN CLASSIFIED OLD GROWTH

Swan River State Forest has had an ongoing salvage and sanitation program for years. This program has resulted in the reduction of some old-growth attributes in many current old-growth stands through the effects of timber harvesting. The effects of these previous entries include lower attribute levels in the following categories: fewer acres with high numbers of large trees, lower snag numbers, and less coarse woody debris.

RELATIONSHIP TO THE SUSTAINED-YIELD CALCULATION

DNRC’s management activities are guided by the philosophy of the SFLMP, the forest management Administrative Rules of Montana (ARM), and other relevant rules and laws including the requirement to calculate an annual sustainable yield. As defined in 77-5-221 MCA and pursuant to 77-5-222 and 223 MCA, the Department is required to recalculate the annual sustained yield at least once every 10 years. The sustained yield calculation is done to determine the amount of timber that can be sustainably harvested, on an annual basis, from forested state trust lands in accordance with all applicable state and federal laws. The most recent sustained yield calculation was approved by the Land Board on October 18, 2004.

The recent sustained yield calculation fully incorporated the philosophy of the SFLMP and all applicable laws, rules and regulations. Biodiversity, forest health, endangered species considerations, and desired future conditions are important aspects of state forest land management—including old-growth management. These factors were modeled in the recent sustained yield calculation and are reflected in the various constraints applied to the model which included management constraints in old-growth stands, SFLMP constraints, and implementation constraints.

The biodiversity and old-growth Administrative Rules that were

incorporated into the sustained yield model were developed with public input. The managed old growth concept means that harvest treatments in old-growth stands contributed to the calculated sustainable yield. For example, maintenance and restoration treatments were allowed to occur periodically in some old-growth stands, while the model also allowed old growth removal treatments to be applied to other stands. Given the concerns expressed by some of the public regarding old growth, the sustained yield model made provisions for tracking old-growth amounts, over the planning horizon in order to determine whether landscape-level biodiversity objectives in the SFLMP and ARMs were met. At the initiation of the model runs, approximately 11 percent of DNRCs forested ownership met the Department's old-growth definition. After incorporating the Department's old-growth management regimes and all relevant constraints into the model, approximately 8 percent of the landscape was intended to be in an old-growth condition at model year 100. The model clearly demonstrates that this is achievable at the current sustained yield of 53.2 MMbf given current management practices, rules, and laws.

This project's effects to old-growth amounts result in postharvest quantities that are well above the range expected to occur over the long-term as a result of implementing the SFLMP and ARM.

OVERALL EFFECTS TO OLD-GROWTH STANDS

TABLE C-11 - OLD-GROWTH FOGI ATTRIBUTE CLASSIFICATION CHANGES PREHARVEST AND POSTHARVEST BY ALTERNATIVE (following page) shows old-growth type and FOGI values for all old-growth stands proposed for treatment in the project area. This table also shows postharvest FOGI values and whether the stands would remain old growth. Seedtree and seedtree-with-reserves treatments would not retain sufficient large live trees postharvest to meet DNRC's old-growth definition, while commercial thinning and shelterwood harvests are expected to meet the definition.

It should be noted that the Department's old-growth definition provides an objective, numerical threshold for labeling a stand as old growth. Because of this objectivity, some stands may remain old growth despite having had some trees harvested because the threshold defining old growth is still exceeded. DNRC is aware that not everyone believes that an old-growth stand can remain an old-growth stand after being harvested. However, the Department adopted its old-growth definition at the urging of several interest groups who were very concerned that the number of large live trees should be the defining component for labeling a stand as old growth. Thus, the apparent anomaly occurs where recently harvested stands could retain sufficient levels of important attributes to remain old growth despite the harvesting that occurred. The definitions also result in the possibility that some acres are shifted from one type of old growth to another because, once again, they would retain sufficient levels of attributes to meet the definition, but shifts in species representation cause a shift in the 'type' of old growth.

ALTERNATIVE EFFECTS TO OLD GROWTH

Direct Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Old Growth***

  In the short term, existing old-growth stands would continue to experience substantial mortality of large Douglas-fir trees, increasing the snag and down-woody-debris components of those stands. Some stands may no longer be in the old-growth classification as a result of the gradual or sudden loss of many

TABLE C-12 - OLD-GROWTH FOGI ATTRIBUTE CLASSIFICATION CHANGES PREHARVEST AND POSTHARVEST BY ALTERNATIVE

CURRENT STAND NUMBER	OLD-GROWTH TYPE	HARVEST PRESCRIPTION	STAND ACRES	PREHARVEST INDEX #	CURRENT FOGI CLASS	EFFECTS BY ACTION ALTERNATIVE											
						B			C			D			E		
						INDEX #	CLASS	OLD-GROWTH POSTHARVEST	INDEX #	CLASS	OLD-GROWTH POSTHARVEST	INDEX #	CLASS	OLD-GROWTH POSTHAVEST	IINDEX #	CLASS	OLD-GROWTH POSTHARVEST
01-03	MC	ST	36	28	High	8	Low	No				8	Low	No			
01-09	MC	STR	29	21	High	10	Low	No				10	Low	No			
03-08	MC	STR	143	24	High	12	Low	No				12	Low	No			
03-09	MC	ST	12	24	High										12	Low	No
03-11	MC	SW	31	25	High				10	Low	Yes						
03-12	MC	SW	9	27	High				10	Low	Yes						
04-15	MC	CT	5	20	Medium	13	Medium	Yes	13	Medium	Yes						
04-18	WL/DF	STR	60	24	High	8	Low	No	8	Low	No	6	Low	No	6	Low	No
04-19	MC	ST	13	22	High	8	Low	No	8	Low	No						
04-20	MC	SW	110	25	High				10	Low	Yes						
04-22	PP	CT	24	21	High				12	Low	Yes	12	Low	Yes			
09-07	MC	SW	80	22	High	10	Low	Yes	10	Low	Yes	10	Low	Yes	10	Low	Yes
09-10	DF	ST	8	13	High	8	Low	No	8	Low	No						
09-12	WWP	CT	19	22	High	12	Low	Yes	12	Low	Yes	12	Low	Yes	12	Low	Yes
09-13	WL/DF	STR	53	18	Medium							11	Low	No			
09-15	WWP	CT	108	16	Medium	12	Low	Yes	12	Low	Yes						
09-18	WL/DF	ST	34	15	Medium	8	Low	No	8	Low	No	8	Low	No	8	Low	No
10-06	MC	CT	85	20	Medium							12	Low	Yes			
10-10	MC	SW	74	18	Medium							8	Low	Yes			
14-13	WWP	CT	36	21	High							12	Low	Yes			
14-14	MC	SW	83	20	Medium							8	Low	Yes			
15-17	MC	SW	61	20	Medium	12	Low	Yes									
16-24	MC	ST	43	22	High	8	Low	No	8	Low	No	8	Low	No	8	Low	No
22-10A	MC	STR	53	21	High	8	Low	No	8	Low	No	8	Low	No	8	Low	No
22-10B	MC	SW	55	21	High	12	Low	Yes	12	Low	Yes	12	Low	Yes			
22-10C	MC	CT	91	21	High	12	Low	Yes	12	Low	Yes	12	Low	Yes			
22-11	MC	STR	59	21	High	8	Low	No	8	Low	No	8	Low	No	8	Low	No
25-12	MC	SW	81	22	High	12	Low	Yes									
25-13	MC	SW	58	22	High	12	Low	Yes									
26-02	MC	SW	134	20	Medium				12	Low	Yes						
27-11A	MC	SW	84	21	High	12	Low	Yes	12	Low	Yes						
27-11B	MC	CT	16	21	High	12	Low	Yes	12	Low	Yes						
27-19	WL/DF	STR	86	22	High	8	Low	No	8	Low	No	8	Low	No	8	Low	No

large trees due to Douglas-fir bark beetles, mountain pine beetles, dwarf mistletoe, drought, competition, etc. These factors can reduce the number of large, live trees below the minimum described in *Green et al. (1992)*. Over the long term, existing old growth would continue to age and become more decadent.

- ***Direct Effects of Action Alternatives B, C, D, and E to Old Growth***

The proposed harvest treatments for all of the action alternatives would affect old growth, as illustrated in *TABLE C-13 - ACRES OF OLD GROWTH PROPOSED FOR HARVESTING BY COVERTYPE.*

Old-growth stands would be harvested with seedtree, seedtree-with-reserves, shelterwood, and commercial-thin treatments. The main objectives for entering these old-growth stands are to remove insect-infested and disease-infected trees, maintain historical covertypes, and remove or reduce shade-tolerant species. Some commercial thinning and shelterwood units may be classified as old growth following harvesting; postharvest data collection in particular stands would determine their classification.

The primary effects to old growth would be the removal of stands from their old-growth classification or a reduction of attribute levels associated with old-growth stands. The old-growth attributes that would be affected include:

– Stocking levels in all treated stands would be reduced. The stocking levels in the commercial-thin units would be approximately half the current levels. Shelterwood units would be reduced to approximately 20 percent of current stocking levels. Stocking levels for seedtree and seedtree-with-reserves units would be approximately 10 percent of current levels (the stands would not be old growth postharvest).

– Stand vigor would improve or remain at existing levels for harvested stands.

TABLE C-13 - ACRES OF OLD GROWTH PROPOSED FOR HARVESTING BY COVERTYPE

			MIXED CONIFER	WESTERN LARCH/ DOUGLAS-FIR	WESTERN WHITE PINE	PONDEROSA PINE	DOUGLAS-FIR	SUBALPINE FIR	TOTALS
Current conditions in project area			3,359	418	346	24	8	328	4,483
ACTION ALTERNATIVE	B	Proposed for harvest	967	120	126	0	8	0	1,221
		Postharvest	2,592	630	346	24	0	328	3,920
	C	Proposed for harvest	844	120	126	24	8	0	1,122
		Postharvest	2,770	549	346	24	0	328	4,017
	D	Proposed for harvest	891	173	55	24	0	0	1,143
		Postharvest	2,633	548	346	24	8	328	3,887
	E	Proposed for harvest	307	120	19	0	0	0	446
		Postharvest	3,133	298	346	24	8	328	4,137

– Stand structures in seedtree, seedtree-with-reserves, and shelterwood units would be reduced to single- or two-storied stand structures following harvesting. Commercial-thin units would be reduced to 2- and 3-storied (multi) stand structures following harvesting.

– Minimum snag retention per acre for all units would consist of 2 trees, 21-inches dbh or greater; if no trees that large are present, the next largest trees would be retained. In addition, 2 snag-recruit trees per acre, 21-inches dbh or greater, would be retained.

– Slash would be piled and burned or otherwise treated on site; approximately 15 tons of coarse woody debris per acre would be retained. Seedtree or seedtree-with-reserve units may, where feasible, have broadcast-burn treatments applied.

– Large, live trees would be removed if they are dying from insect or disease attacks or to provide openings for regeneration. Seedtree and seedtree-with-reserve units would retain 6 to 8 trees per acre, with emphasis given to larger diameter trees. Health, vigor, cone production, and other factors would be considered when selecting trees for retention purposes. Shelterwood units would have a retention level of 12 to 16 trees per acre, with the same selection criteria as used on seedtree units. Commercial-thin units would retain 80 to 120 trees per acre, or 40- to 50-percent canopy cover, with priority given to the healthier, better-formed individuals in the stand.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Old Growth***

  Not harvesting in old-growth stands would continue the existing risk of stand-replacement-type fires that would likely consume portions of the old-growth stands in their paths.

  Existing open roads would continue to provide access to firewood gatherers, reducing the development of snags and coarse woody debris on those sites.

  Over time and barring large scale disturbances, old-growth attribute levels would increase on most covertypes as climax species mature, decadence increases, and trees die and fall, creating more snags and large woody debris. However, the large-tree component is likely to be reduced over time as large shade-intolerant species die and are replaced by smaller shade-tolerant species with a lesser chance of becoming large.

  These same stands would also reach a point where the old-growth attribute levels decrease. As large trees continue to age and eventually die, some stands would no longer meet the old-growth definition.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Old Growth***

  All action alternatives would harvest timber in or near old-growth stands and create more abrupt stand edges. Some mature stands not yet classified as old growth could be considered old growth in the future. Commercial-thin harvests within these mature stands would increase the diameter growth rates of remaining trees and, in some cases, may hasten the development of old-growth attributes, especially large-diameter trees.

Cumulative Effects

The Swan River State Forest salvage program has completed limited harvesting in old growth on the High Blow ‘02, Big Blowdown, Cilly Bug, and Rock Squeezer salvage sales. Currently, the Red Ridge Timber Sale Project is completing some harvesting in old-growth stands. The Fridge Salvage environmental review has been completed and harvesting will begin this winter.

It should be noted that timber stands, whether harvesting occurs or not, may be reinventoried or reindexed in regard to adjustments of stand boundaries; a more intensive inventory may change the old-growth status.

Past road construction, timber harvests, wildfires, and general site characteristics have led to the current amount of old-growth characteristics in the entire area. The salvage harvesting would not alter old-growth designation, but would reduce numbers of large snags and coarse woody debris and potentially decrease stand decadence. Future timber sales and thinning projects would likely continue to take place in the analysis area. If additional management projects were proposed, the MEPA process would be implemented.

- ***Cumulative Effects of No-Action Alternative A to Old Growth***

  Current levels of old-growth acres would not change in the short term. As stands continue to mature and large trees eventually die, some stands may no longer meet the old-growth definition. Ongoing data collection of stands may change the amount of acres classified as old growth.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Old Growth***

  Action Alternative B would harvest approximately 1,222 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 12.6 percent. Following harvesting operations, 564 acres would no longer meet old-growth criteria, while 658 acres would retain the old-growth classification. The amount of old growth remaining on Swan River State Forest would be 11,914 acres, and the proportion of acreage classified as old growth would be 30.9 percent.

  Action Alternative C would harvest approximately 1,122 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 7.9 percent. Following harvesting operations, 466 acres would no longer meet old-growth criteria, while 656 acres would retain old-growth classification. The amount of old-growth acres remaining on Swan River State Forest would be 12,012 acres, and the proportion of acreage classified as old growth would be 31.2 percent.

  Action Alternative D would harvest approximately 1,143 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 13.3 percent. Following harvesting operations, 596 acres would no longer meet old-growth criteria, while 547 acres would retain old-growth classification. The amount of old growth remaining on Swan River State Forest would be 11,882 acres, and the proportion of acreage classified as old growth would be 30.8 percent.

  Action Alternative E would harvest approximately 446 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 7.7 percent. Following harvesting operations, 347 acres would no longer meet old-growth criteria, while 99 acres would

retain old-growth classification. Swan River State Forest would contain 12,131 acres of old growth; the proportion of acreage classified as old growth would be 31.5 percent.

Recognizing that the amounts and distributions of all age classes would shift and change over time, the amount of old growth remaining is within an expected range of natural variation.

AGE AND COVERTYPE PATCH SIZE

AGE PATCHES

Traditionally, forest management has focused on forest stands, which are typically defined as units with similar characteristics of tree species, tree sizes, and stocking levels. However, some understanding of the environment can be gained by examining different groupings of stands according to fewer characteristics such as age class or covertype. For example, the size of patches of equivalent age is one way to assess effects of management activities to the forested landscape. Age-class patches broadly reflect disturbance in the natural environment and the additional influence of harvesting and associated activities in the managed environment.

Forests change over time. Tracking the changes from historical to current conditions can indicate the effects of management and whether the direction of change is desirable. Assessing historic forest conditions is fraught with challenges, such as a lack of actual data or, even when data is available, compatibility with current information. DNRC has maps of an inventory conducted in the 1930s that provide a general baseline for age (and covertype) patches for Swan River State Forest and the project area. The data does not provide for a seamless comparison between historic and current conditions due to differences in mapping procedures, primarily an eight-fold difference in minimum map-unit size (40 acres historically and 5 acres currently). The reduced minimum-map unit size results in many more patches of a smaller average size, even when applied to the same forest at the same point in time. However, the data does represent the best historic information available; therefore, the data is presented with the caveats mentioned in this paragraph.

This analysis focuses on stand age classes. The oldest age class also encompasses all old-growth stands. However, old growth would represent only a portion of all old-age stands, as not all old stands would meet the large-tree requirements that are part of DNRC's old-growth definitions. Reconstructing the historic data to quantify patch characteristics of old growth is not possible, and, so, comparisons between historic and current conditions are not made. An analysis of the current patch characteristics of old growth and the effects of each action alternative is presented below (see *OLD-GROWTH PATCHES*).

Historic data indicates that old-stand patches were very large in both Swan River State Forest and the project area, with the patches being much larger in the project area than for the entire Swan River State Forest (*TABLE C-14 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR SWAN RIVER STATE FOREST, IN ACRES* and *TABLE C-15 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR THE PROJECT AREA, IN ACRES*). Historically, a single large old-stand patch, exceeding 14,000 acres, dominated Swan River State Forest and the project area (previous DNRC analysis indicates that large stands would be divided into many additional polygons using today's mapping protocols, even in the absence of any harvest-related

activities). Other age patches were variable in size between the project level and Swan River State Forest. The expectation is that the project area would naturally have smaller patch-size means due to imposing the artificial project area boundary onto some existing patches. On average, current age-class patches are much smaller than historically. Some of the decrease can be attributed to different map-unit minimums, but the data likely reflects a real reduction in mean patch sizes, as harvesting and roads have broken up some previously intact patches.

Current old-stand patches are much smaller at the scale of Swan River State Forest than they were historically. Project area old-stand patches are larger than the historic mean for Swan River State Forest, but are approximately one-third the size of historic patches in the project area. At the scales of both the project area and Swan River State Forest, all other age patches are smaller currently than historically.

Alternative Effects to Age Patch

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Patch Size***

  Patch sizes would not be immediately affected. Over time, the forest would tend to homogenize, leading to larger patches of older stands, especially in the absence of significant fires or other disturbance events.

- ***Direct and Indirect Effects of All Action Alternatives on Patch Size***

  Within the project area, the mean old-stand patch size would be reduced to about one half of current means with all action alternatives. Action Alternative B would reduce old-stand patch size the most, with the other action alternatives being roughly equivalent (*TABLE C-15 - PROJECT*

TABLE C-14 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR SWAN RIVER STATE FOREST AND THE THREE CREEKS TIMBER SALE PROJECT AREA, IN ACRES

AGE CLASS	SWAN RIVER STATE FOREST		PROJECT AREA	
	HISTORIC	CURRENT	HISTORIC	CURRENT
None	120.9	20.4	162.8	19.5
0 to 39 years	91.0	35.1	78.9	32.6
40 to 99 years	134.5	60.1	102.9	68.8
100 to old stand	76.4	51.1	136.1	55.3
Old stand	664.8	183.1	2,487.0	809.9
Overall	280.0	64.3	377.7	105.7

TABLE C-15 – PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR ACTION ALTERNATIVES B, C, D, AND E, IN ACRES

AGE CLASS	ACTION ALTERNATIVE			
	B	C	D	E
None	19.5	19.5	19.5	19.5
0 to 39 years	102.2	103.6	88.4	85.5
40 to 99 years	65.1	65.1	65.2	68.0
100 to old stand	65.2	62.7	52.6	48.5
Old stand	360.8	397.6	402.1	393.2
Overall	112.4	113.6	104.6	106.7

AREA POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR ACTION ALTERNATIVES B, C, D, AND E, IN ACRES). Other age patches would be only marginally affected, except the 0-to-39-year-old class, where mean patches would be increased with each action alternative, reflecting the effort to group stand-replacement harvesting near other previously harvested areas. Although the patch size of the youngest age class would be increased with each action alternative, the overall mean age-class patch would remain considerably smaller than the historic mean.

Compared to current conditions, project-level effects indicate that Action Alternatives B, C, and E would slightly increase the mean size of age patches, while Action Alternative D would slightly decrease the mean. This would occur despite large decreases in mean patch size of the oldest age class with each action alternative.

Cumulative Effects

- ***Cumulative Effects of All Alternatives on Patch Size***

The current age-class patch condition reflects the effects of natural disturbances and succession and the cumulative effects of previous activities by DNRC that have been completed and mapped. Overall, age patches for the entire forest and the project area are reduced from historic to current conditions. Other ongoing projects that have not been mapped to date would have a slight effect of decreasing patch sizes at the scale of Swan River State Forest through conversion of approximately 360 acres of various age classes to the 0-to-39-year age class through regeneration harvesting. Within the project area, cumulative effects of other harvests have been incorporated.

OLD-GROWTH PATCHES

Old growth represents a subset of the old-stand age class. Old stands must contain a specified number and size of ‘large’ live trees to meet the old-growth definition; those large trees must also meet or exceed minimum age requirements. This analysis displays current patch-size characteristics of old growth and the effects of each alternative. This analysis does not present a corresponding analysis of historical old-growth patch characteristics because the data does not exist. Although it cannot be verified with observations of historic old-growth patch size, the reductions in patch size of old-age stands is expected to reflect a similar reduction in patch size of old-growth stands, but the absolute magnitude is unknown.

Currently, the mean patch size of old-growth stands on Swan River State Forest is 123.5 acres (*TABLE C-16 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND WITHIN THE PROJECT AREA, IN ACRES*). Within the project area, the mean old-growth patch size is 344.9 acres. Old-growth patches are about one-third to one-half the mean size of old-stand patches. The disparity between patch sizes of old stands and old growth reflects the addition of the large tree number, size, and age requirements.

Alternative Effects to Old-Growth Patches

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Old-Growth Patches***

The patch size of old-growth stands would not be immediately affected. Over time, the effects to old-growth patch size would be uncertain because it would depend on the development of large live trees within old-age stands and because current insect and disease infestations are killing many

TABLE C-16 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND WITHIN THE PROJECT AREA, IN ACRES

SWAN RIVER STATE FOREST	**PROJECT AREA**	**ACTION ALTERNATIVE**			
		B	**C**	**D**	**E**
123.5	344.9	165.5	156.3	155.3	212.3

large trees, causing the stands to fall out of the old-growth classification. If existing large live trees remain alive and new large trees develop in old-age stands, the mean patch size of old growth would be expected to increase. Conversely, if existing large live trees continue to die and new ones fail to develop because of overly dense stands, the mean patch size of old growth would be expected to decrease.

- ***Direct and Indirect Effects of All Action Alternatives on Old-Growth Patches***

Each action alternative would reduce the mean patch size of old growth within the project area (*TABLE C-16 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND WITHIN THE PROJECT AREA, IN ACRES*). Action Alternative D would reduce the mean patch size of old growth the most (by 189.6 acres), while Action Alternative E would reduce it the least (by 132.6 acres). At the scale of Swan River State Forest, old-growth patch sizes would be reduced with each action alternative. Action Alternative D would result in the largest decrease (19.4 acres), while Action Alternative E would result in the smallest decrease (11.1 acres), with the other alternatives intermediate in their decrease.

Cumulative Effects

- ***Cumulative Effects of All Alternatives on Old-Growth Patches***

The current old-growth-patch condition reflects the effects of natural disturbance and succession and the cumulative effects of previous activities by DNRC that have been completed and mapped. Overall, old-growth patches for the entire forest and the project area are likely reduced from historic to current conditions. Other ongoing projects have not entered old-growth stands. Within the project area, cumulative effects of other harvests have been incorporated into the *Effects Analysis*.

COVERTYPE PATCHES

Historic data suggests mean covertype patch sizes are similar to age patch sizes, in part, due to the single large patch of old western larch/Douglas-fir that dominated the forest and project area. As with mean age-class patch sizes, the differences in mapping protocols and, in particular, a different minimum map-unit size confound direct comparison and drawing clear conclusions. However, a real decrease in mean covertype patch size is expected due to the effects of harvesting and road building. The effects of succession confound the results and are reflected in the increased patch size of shade-tolerant types (mixed-conifer and subalpine fir types).

Overall, current covertype patches on Swan River State Forest and the project area are about one-third the size of the historic mean (*TABLE C-17 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR SWAN RIVER STATE FOREST, IN ACRES* and *TABLE C-18 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR THE PROJECT AREA, IN ACRES*). Currently, the project area covertype patches tend to be larger than for Swan River State Forest.

Alternative Effects to Covertype Patches

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A on Covertype Patches***

  The covertype patch sizes would not be immediately affected; however, over time, diversity of habitats in terms of covertype patches would likely be reduced through forest succession. The result would be an increase in mean size of patches dominated by shade-tolerant species as shade-intolerant species are excluded.

- ***Direct and Indirect Effects of All Action Alternatives on Covertype Patches***

  Each action alternative would slightly reduce the average covertype patch size (*TABLE C-19 - PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY COVERTYPE FOR EACH ALTERNATIVE, IN ACRES*). Action Alternative D would reduce the mean patch size the most, Action Alternative E the least. The greatest changes in cover patch sizes would occur within two types, the mixed-conifer and the western larch/Douglas-fir patches. The mixed-conifer patches would be reduced in size with each action alternative, Action Alternative B the most and Action Alternative E the least. The western larch/ Douglas-fir patches would be increased in size with each action alternative, Action Alternative C the most and Action Alternative D the least. Other covertype patch sizes would only be affected marginally or not at all by the project.

Cumulative Effects

- ***Cumulative Effects of All Alternatives on Covertype Patches***

  The current covertype patch condition reflects previous activities by DNRC and natural disturbances and succession that have been completed and mapped.

TABLE C-17 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR SWAN RIVER STATE FOREST, IN ACRES

COVERTYPE CLASS	HISTORIC	CURRENT
Douglas-fir	-	28.0
Hardwood	28.5	19.7
Lodgepole pine	94.9	38.2
Mixed conifer	119.3	168.8
Noncommercial	85.2	-
Nonforest	32.9	18.0
Nonstocked	-	17.6
Ponderosa pine	127.3	42.9
Subalpine	170.9	232.6
Water	25.6	21.9
Western larch/ Douglas-fir	792.8	64.7
Western white pine	157.9	75.0
Overall	223.4	73.4

TABLE C-18 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR THE PROJECT AREA, IN ACRES

COVERTYPE CLASS	HISTORIC	CURRENT
Douglas-fir	-	11.8
Lodgepole pine	107.2	49.9
Mixed conifer	455.3	528.5
Noncommercial	84.9	-
Nonforest	29.3	19.5
Nonstocked	-	41.6
Ponderosa pine	79.4	22.8
Subalpine fir	186.3	428.8
Western larch/ Douglas-fir	3,110.3	87.7
Western white pine	634.5	81.4
Overall	440.3	144.8

TABLE C-19 – PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY COVERTYPE FOR EACH ALTERNATIVE, IN ACRES

COVERTYPE CLASS	ACTION ALTERNATIVE			
	B	**C**	**D**	**E**
Douglas-fir	10.2	10.2	11.8	11.8
Lodgepole pine	49.9	49.9	49.9	49.9
Mixed conifer	212.7	224.8	259.0	309.4
Nonforested	19.5	19.5	19.5	19.5
Nonstocked	41.6	41.6	41.6	41.6
Ponderosa pine	22.8	16.1	16.1	22.8
Subalpine fir	428.8	428.8	428.8	428.8
Western larch/Douglas-fir	140.1	150.0	99.6	113.1
Western white pine	97.4	86.7	116.5	71.7
Overall	130.5	130.5	125.8	132.1

Overall, covertype patch sizes have been reduced from historic to current conditions. Other ongoing projects that have not been mapped to date would have a slight effect of decreasing patch sizes at the scale of Swan River State Forest. Within the project area, cumulative effects of other harvests have been incorporated.

SENSITIVE PLANTS

ANALYSIS METHODS

The Montana Natural Heritage Program (http://www.nhp.nris.mt.gov) database was searched in May 2003 for plant species and the habitat that would support these plants in the vicinity of Swan River State Forest. Botanists were contracted to perform a site-specific survey for sensitive plants within the project area. Results of this search were compared to the location of proposed harvest sites for potential direct and indirect impacts and the need for mitigation measures.

The majority of sensitive plants and their related habitat features were found in wet meadows, areas that are not normally classified as forest stands or considered for timber harvesting. The survey identified 9 species of special concern, existing within a total of 19 separate populations (*Pierce and Barton 2003*); none of these plant populations are within the project area.

ALTERNATIVE EFFECTS TO SENSITIVE PLANTS

No effects are expected because no populations of sensitive plants occur within the project area.

Cumulative Effects

- ***Cumulative Effects of All Action Alternatives to Sensitive Plants***

  If changes occur in the water yield or nutrient level, sensitive plant populations may, in turn, be affected. Given the level of the proposed and active harvesting on Swan River State Forest and other land in the project area, no measurable changes in water yield or surface water levels are anticipated from any of the proposed action alternatives in South Fork Lost or Soup creeks. No measurable changes in water yield or surface water levels are anticipated from Action Alternatives B or C in Cilly Creek. Water yield and surface water levels could increase slightly from Action Alternatives D and E in Cilly Creek. No change in nutrient levels would occur due to mitigation measures designed to prevent erosion and sediment delivery.

NOXIOUS WEEDS

INTRODUCTION

Spotted knapweed (*Centaurea mauclosa* Lam.), orange hawkweed (*Hieracium aurantiacum*), and common St. Johnswort (*Hypericum perforatum* L.) have become established along road edges within the project area. Swan River State Forest has begun a program to reduce the spread and occurrence of noxious weeds.

ALTERNATIVE EFFECTS

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Noxious Weeds***

  Noxious weed populations would continue as they exist. Weed seed would continue to be introduced by recreational use of the forest and log hauling and other logging activities on adjacent ownerships. Swan River State Forest may initiate spot spraying to reduce noxious weed spread along roads under the FI program.

- ***Direct and Indirect Effects of All Action Alternatives to Noxious Weeds***

  Logging disturbance would provide opportunities for increased establishment of noxious weeds; log hauling and equipment movement would introduce seeds from other sites. Occurrence and spread of existing or new noxious weeds would be reduced by mitigation measures in the form of integrated weed-management techniques. Grass seeding of new and disturbed roads and landings and spot spraying of new infestations would reduce or prevent the establishment of new weed populations. Requiring contractors to wash and inspect machinery prior to entering the project area would reduce the introduction of noxious weed seeds. Roadside herbicide spraying would reduce existing populations of noxious weeds. All herbicide applications would follow label directions, avoid introduction of chemicals into riparian systems, and target only the intended species of noxious weeds.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Noxious Weeds***

  Salvage logging on State land and logging activities on adjacent lands would continue to provide opportunities for noxious weeds to become established. Current population levels would continue to exist and may increase over time.

- ***Cumulative Effects of All Action Alternatives to Noxious Weeds***

  The action alternatives, together with other management and recreational activities on Swan River State Forest, would provide an opportunity for the transfer of weed seed and increased establishment of noxious weeds. Preventative actions facilitated by the Lake County Weed Board and active weed-management activities performed by Swan River State Forest would reduce the spread and establishment of noxious weeds, as well as the impacts resulting from the replacement of native species. Swan River State Forest would continue to perform weed management through this action depending on funding levels.

ATTACHMENT C-1
OLD-GROWTH ATTRIBUTE ASSIGNMENTS

LARGE LIVE TREES

Listing the # of trees in the (21″ or greater **dbh** category), first, and the (17″ or greater **dbh** category) second: all possible combinations are shown for each class.

Lots = (11, 11)

Some = (6, 11); (6, 6); (1, 11)

Few = (1, 6); (1, 1); (0, 11); (0, 6)

None = (0, 0); (0, 1)

LARGE COARSE WOODY DEBRIS

DWOODSM = # small pieces (< 16″ **dbh**) of CWD within a 300 - foot transect

DWOODLG = # large pieces (> 16″ **dbh**) of CWD within a 300 - foot transect

CWDNEW = DWOODSM + (3 * DWOODLG)

Lots = CWDNEW ^{3} 27

Some = CWDNEW ^{3} 14 and <27

Few = CWDNEW ^{3} 3 and <14

None = CWDNEW 0,1, or 2

SNAGS

Lots =[6 snags at 21″ or greater dbh] or [11 snags at 15 to 20 inch dbh] possible combinations: listing the 21″or greater dbh snag category), first and the (15″ to 20″ dbh snag category), second are (6,0), (6,1), (6,6), (6,11), (11,0), (11,1), (11,6), (11,11), or (0,11), (1,11)

Some = [1 snag at 21″ or greater dbh] or [6 snags at 15″or greater dbh] possible combinations: listing the (21″or greater dbh snag category), first and the (15″ to 20″ dbh snag category), second are (1,0), (1,1), (1,6), or (0,6)

Few = [0 snags at 21″ or greater dbh] or [1 to 5 snags at 15″ to 20″ dbh] possible combinations: listing the (21″or greater dbh snag category), first and the (15″ to 20″ dbh snag category), second are (0,1)

None = [0 snags at 21″ or greater dbh and 0 snags at 15″ to 20″ dbh) possible combinations: listing the (21″or greater dbh snag category), first and the (15″ to 20″ dbh snag category), second are (0,0)

DECADENCE

Lots = stand mortality likely exceeds growth.
Some = closed canopy with crown ratios less than 33%. Growth and mortality approximately equal.
Little = Canopies mostly closed with crown ratios between 33 and 50%. Growth rates exceed mortality.
None = open canopy and growth is optimal.

APPENDIX D
WATERSHED AND HYDROLOGY ANALYSIS

INTRODUCTION

The issue was raised that timber harvesting and associated activities may cause sediment delivery to streams and may increase water yield.

- ***SEDIMENT DELIVERY***

  Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams. Construction of roads, skid trails, and landings can generate and transfer substantial amounts of sediment through the removal of vegetation and exposure of bare soil. In addition, removal of vegetation near stream channels reduces the sediment-filtering capacity and may reduce channel stability and the amounts of large woody material. Large woody debris is a very important component of stream dynamics, creating natural sediment traps and energy dissipaters to reduce the velocity and erosiveness of streamflows.

- ***WATER YIELD***

  Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Water yields increase proportionately to the percentage of canopy removal, because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which lead to further increases in water yield. Higher water yields may lead to increases in peak flows and peak-flow duration, which can result in accelerated streambank erosion and sediment deposition.

TABLE OF CONTENTS

Introduction D-1
Analysis Methods D-1
Analysis Area D-3
Existing Conditions D-3
Alternative Effects D-9

ISSUES RAISED DURING SCOPING

Concern was raised by the public that non-point sources of sediment, known existing sources of sediment, and human– and management-caused sources of sediment should be mitigated and repaired with the proposed project. Identification of non-point sources of sediment and human-caused sediment and planned mitigation of these sources will be addressed under the *EXISTING CONDITIONS* and *ALTERNATIVE EFFECTS* sections of this analysis.

ANALYSIS METHODS

- ***SEDIMENT DELIVERY***

  Methodology for analyzing sediment delivery was completed using a sediment-source inventory. All roads and stream crossings were evaluated to determine sources of introduced sediment. In addition, in-channel sources of sediment were identified using channel-stability rating methods developed by *Pfankuch (1975)* and through the conversion of stability rating to reach condition by stream type developed by *Rosgen (1996)*. These analyses were conducted in 1999 by a contracted firm and verified by a DNRC hydrologist. In addition, data were collected in 2003 to quantify road surface sediment delivery using procedures adapted from the *Washington Forest Practices Board* (*Callahan, 2000)*. The same procedures used to

estimate road-surface sediment delivery for the existing road system were used to estimate the road-surface sediment delivery reductions from proposed road BMP improvements and to estimate the road-surface sediment delivery increases from proposed new road construction and new stream-crossing installations. Risk of potential sediment delivery was evaluated for existing log/earth fill sites and bridge sites with log-crib retaining walls at risk of failure. Potential sediment delivery from fill failure at these sites was assessed by estimating the volume of fill contained at each site and converting the value to tons.

- ***WATER YIELD***

  The water-yield increase for the watershed in the project area was determined using the ECA method as outlined in *Forest Hydrology Part II (Haupt, 1976)*. ECA is a function of total area roaded and harvested, percent of crown removal in harvesting, and amount of vegetative recovery that has occurred in harvest areas. This method equates area harvested and percent of crown removed with an equivalent amount of clearcut area. For example, if 100 acres had 60 percent crown removed, ECA would be approximately 60, or equivalent to a 60-acre clearcut. The relationship between crown removal and ECA is not a 1-to-1 ratio, so the percent ECA is not always the same as the percent canopy removal. As live trees are removed, the water they would have evaporated and transpired either saturates the soil, or is translated to runoff. This method also calculates the recovery of these increases as new trees vegetate the site and move toward preharvest water use.

In order to evaluate the watershed risk of potential water-yield increase effectively, a threshold of concern must be established. In order to determine a threshold of concern, acceptable risk level, resource value, and watershed sensitivity are evaluated according to *Young (1989)*. The watershed sensitivity is evaluated using qualitative assessments, as well as procedures outlined in *Forest Hydrology Part II (Haupt, 1976)*. The stability of a stream channel is an important indicator of where a threshold of concern should be set. As water yields increase as a result of canopy removal, the amount of water flowing in a creek gradually increases. When these increases reach a certain level, the bed and banks may begin to erode. More stable streams will be able to handle larger increases in water yield before they begin to erode, while less stable streams will experience erosion at more moderate water-yield increases.

RISK-ASSESSMENT CRITERIA

Where risk is assessed in both sediment-delivery and water-yield analyses, the following definitions apply to the level of risk reported:

- low risk means impacts are unlikely to result from proposed activities,
- moderate risk means there is approximately a 50-percent chance of impacts resulting from proposed activities, and
- high risk means impacts are likely to result from proposed activities.

Where levels or degrees of impacts are assessed in this analysis, the following definitions apply to the degree of impacts reported:

- very low impact means that impacts from proposed activities are unlikely to be measurable or detectable and are not likely to be detrimental to the water resource;
- low impact means that impacts from proposed activities would likely be measurable or detectable, but

are not likely to be detrimental to the water resource;

- moderate impact means that impacts from proposed activities would likely be measurable or detectable, and may or may not be detrimental to the water resource; and
- high impact means that impacts from proposed activities would likely be measurable or detectable, and are likely to have detrimental impacts to the water resource.

ANALYSIS AREA

- ***SEDIMENT DELIVERY***

The analysis area for sediment delivery is the area of the Three Creeks Timber Sale Project and the proposed haul routes. This includes portions of the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds. South Fork Lost Creek is a 10,503-acre, perennial, third-order tributary to Lost Creek and Swan River. The Cilly Creek watershed is a 5,266-acre third-order tributary to Swan River. The Soup Creek watershed is a 9,787-acre third-order tributary to Swan River. Analysis will cover stream segments within these watersheds that may be affected by the proposed project and all roads and upland sites that may contribute sediment to South Fork Lost, Cilly, or Soup creeks.

- ***WATER YIELD***

The analysis areas for water yield are the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds. The South Fork Lost Creek is a 10,503-acre third-order watershed. Precipitation in the South Fork Lost Creek watershed ranges from 30 inches at its confluence with North Fork Lost Creek to 90 inches at the ridge tops. The Cilly Creek watershed is a 5,266-acre tributary to Swan River; annual precipitation ranges from 30 inches in the lower elevations to 80 inches at the ridge tops. The Soup Creek watershed is a 9,787-acre tributary to Swan River; annual precipitation ranges from 30 inches in the lower elevations to 90 inches at the ridge tops.

EXISTING CONDITIONS

REGULATORY FRAMEWORK

Montana Surface Water-Quality Standards

According to *ARM 17.30.608 (2)(a)*, the Swan River drainage, including South Fork Lost, Cilly, and Soup creeks, is classified as B-1. Among other criteria for B-1 waters, no increases are allowed above naturally occurring levels of sediment, and minimal increases over natural turbidity. "Naturally occurring," as defined by *ARM 17.30.602 (17)*, includes conditions or materials present during runoff from developed land where all reasonable land, soil, and water conservation practices (commonly called BMPs) have been applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after completion of potentially impactive activities.

Designated beneficial water uses within the project area include cold-water fisheries and recreational use in the streams, wetlands, lake, and surrounding area. The Cilly Creek watershed has domestic water use and irrigation water rights as beneficial uses.

Water-Quality-Limited Waterbodies

None of the streams in the proposed project area are currently listed as water-quality-limited waterbodies in the *1996, 2002,* or *2004 Montana 303*

(d) list. Swan Lake is currently listed on the *2004 Montana 303(d)* list, but was not listed on the 1996 list. The 303(d) list is compiled by the DEQ as required by *Section 303(d)* of the *Federal Clean Water Act* and the *EPA Water Quality Planning and Management Regulations (40 CFR, Part 130)*. Under these laws, DEQ is required to identify waterbodies that do not fully meet water-quality standards, or where beneficial uses are threatened or impaired. These waterbodies are then characterized as "water quality limited" and are, thus, targeted for TMDL development. The TMDL process is used to determine the total allowable amount of pollutants in a waterbody of a watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water-quality standards.

The *Montana Water Quality Act (MCA 75-5-701* through *705)* also directs DEQ to assess the quality of State waters, ensure that sufficient and credible data exists to support a 303(d) listing, and develop TMDL for those waters identified as threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint-source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices. DNRC will comply with the TMDL Law and interim guidance developed by DEQ through implementation of all reasonable soil and water conservation practices, including BMPs and the Rules.

Swan Lake is currently listed as threatened for aquatic life support and cold-water fisheries. The current listed cause of impairment in Swan Lake is siltation; the probable sources include building construction, highway/road/bridge construction, logging road construction and maintenance, and silviculture. Through the Swan Lake Watershed Group and its associated Swan Lake Technical Advisory Group, a water-quality restoration plan was developed for Swan Lake in June 2004. The Swan Lake Watershed Group and Technical Advisory Group are comprised of local stakeholders and include:

- the Swan Ecosystem Center, Flathead Lake Biological Station at Yellow Bay, and Friends of the Wild Swan;
- landowners, including the USDA Forest Service, Montana DNRC, Plum Creek Timber Company; and
- regulatory agencies, including DEQ and EPA.

The *Water Quality Restoration Plan* was approved by EPA in August 2004, and activities are ongoing to correct current sources and causes of sediment to Swan Lake and its tributaries. DNRC is an active partner and participant in this process. All proposed activities within the project area would implement actions to alleviate identified sources of sediment and comply fully with all TMDL requirements.

Montana SMZ Law

By the definition in *ARM 36.11.312 (3)*, the majority of the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds are class 1 streams. All of these streams and many of their tributaries have flow for more than 6 months each year. Many of these stream reaches also support fish. Some of the smaller first-order tributaries may be classified as class 2 or 3 based on site-specific conditions.

- ***SEDIMENT DELIVERY***

  - **South Fork Lost Creek**

    Based on field reconnaissance from 2003 to 2005, stream channels in the South Fork Lost Creek watershed are primarily in good to fair condition. One reach was rated in poor condition and is located on and

around the section line between Sections 2 and 3 where USFS lands are intermixed with DNRC lands. The reach represents less than 5 percent of the total length of streams in the watershed and is located on both State trust and FNF lands. The primary reason for the poor-stability rating is a midchannel gravel bar that is a result of debris jams. The South Fork Lost Creek watershed has a high supply of small- to moderate-sized woody material due to large avalanche chutes in the headwater portions of the drainage. Material deposited after an avalanche is prone to forming debris jams that periodically break. With continuous forming and reforming of debris jams, gravel bars frequently form upstream of the jam features.

Most reaches of channel were rated as B3 and B4 channels using a classification system developed by *Rosgen (1996)*. Channel types rated as “B” are typically in the 2- to 4-percent gradient range, and have a moderate degree of meander (sinuosity). Channel-bed materials in B3 and B4 types are mainly cobble and gravel. Given the cobble and gravel beds and the gradient of these stream types, bed materials commonly move. Gravel bars have formed on point bars in these reaches (point bars are areas of natural deposition found on the inside of a meander bend). No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in *APPENDIX E - FISHERIES ANALYSIS*. Little evidence of past streamside harvesting was found, and where past logging took place in the riparian area, no deficiency of existing or potential down woody material was apparent in the streams.

- **Cilly Creek**

Based on field reconnaissance from 2003 to 2005, stream reaches in the Cilly Creek watershed were rated in good to fair condition. Cilly Creek flows perennially in most reaches, but flow becomes subsurface during the summer and fall in some low-gradient reaches in the valley bottom.

Stream reaches in the upper portions of the watershed are mainly A3 and A4 channels using a classification system developed by *Rosgen (1996)*. Channel types rated as “A” are typically steeper than 4-percent gradient and have a low degree of meander (sinuosity). Channel-bed materials in A3 and A4 types are mainly cobble and gravel. Stream reaches are mainly B4 and B5 in the lower portions of the watershed. Channel-bed materials in B4 and B5 channels are mostly gravel and coarse sand. Given the cobble, gravel, and coarse sand beds and the gradient of these stream types, bed materials commonly move. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large

woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in *APPENDIX E - FISHERIES ANALYSIS*. Little evidence of past streamside harvesting was found, and, where past logging took place in the riparian area, no deficiency of existing or potential down woody material was apparent in the streams.

- **Soup Creek**

Based on field reconnaissance from 2003 to 2005, stream channels in the Soup Creek watershed are primarily in good to fair condition. An unnamed tributary to Soup Creek had reaches in the lower elevations rated in poor condition. This tributary begins in Section 23 on FNF land and flows west through Section 22 of the proposed project area. About 0.5 mile of stream on this tributary is rated in poor condition. This reach represents less than 3 percent of the total length of streams in the watershed. The primary reason for poor reach rating is a gully cutting through an alluvial fan. Alluvial fans are areas where stream material has been deposited for millennia, are similar to a river delta, and are usually found where a stream comes out of a steep canyon onto a broad, flat valley bottom. Alluvial fans commonly have streams that shift and jump from one channel to another because the material is easily moved by flowing water. The rest of the channel stability in Soup Creek is described below.

Most reaches of the channel were classified as B3 using a classification system developed by *Rosgen (1996)*. Channel types rated as "B" are typically in the 2- to 4-percent gradient range, and have a moderate degree of meander (sinuosity). Channel bed materials in B3 types are mainly cobble with some boulders and gravel. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in *APPENDIX E - FISHERIES ANALYSIS*. The lower reaches of the watershed flow through a series of wetlands and beaver ponds. The beaver dams can lead to changing water levels in the stream, but the wetlands and beaver ponds tend to moderate the high runoff periods and settle out sediment and channel bed materials that may be carried downstream during runoff. Past management of streamside stands occurred in the lower reaches of the watershed. Where past logging took place in the riparian area, no deficiency of existing or potential down woody material was apparent in the stream.

- **Road System**

The existing road system located within and leading to the proposed project area was reviewed for existing and potential sources of sediment. In-channel and out-of–channel sediment-source reviews were conducted by DNRC hydrologists and fisheries biologists, and PBS&J Consulting (formerly Land and Water Consulting) in association with the development of the *Swan Lake Water Quality Protection Plan* and TMDL (*DEQ 2005*). Based on the sediment-

source review conducted for the Swan Lake TMDL, several existing sources of sediment were identified on the existing road system. Each of the sources identified in this analysis are either found on DNRC ownership or are associated with roads that are under a Cost-Share Agreement entered into by DNRC and FNF. Most of the delivery sites are located at stream crossings, but a portion of the South Fork Lost Creek road system was also identified as a chronic source of sediment delivery to South Fork Lost Creek. On this segment of road, portions of the road fill are located within the normal high-water mark of the stream, and over 0.5 mile of road is capable of delivering sediment to the stream. Another site that was found to contribute large volumes of sediment is located in the Soup Creek canyon. An existing bridge over Soup Creek is aging and becoming rotten. The east road approach to this crossing is on a steep grade and has no surface-drainage relief, making it a chronic source of sediment delivery. The total estimated sediment delivery from roads in the project area to South Fork Lost, Cilly, and Soup creeks are displayed in *TABLE D-1 - ESTIMATED SEDIMENT DELIVERY TO STREAMS FROM THE EXISTING ROAD SYSTEM*. These sediment-delivery values are estimates based on procedures outlined above and are not measured values.

TABLE D-1 - ESTIMATED SEDIMENT DELIVERY TO STREAMS FROM THE EXISTING ROAD SYSTEM

	SOUTH FORK LOST CREEK	**CILLY CREEK**	**SOUP CREEK**
Existing tons per year	19.8	2.9	35.6

Estimated sediment delivery occurs primarily at stream crossings, and sediment comes from a variety of sources. The South Fork Lost Creek and Soup Creek watersheds each contain existing crossings constructed of wood and earth that are in various stages of decay. These crossings are located on DNRC-managed lands on roads that have not been used for several decades. South Fork Lost Creek has 2 wooden bridges with log crib abutments that were constructed in the 1960s; the wood is very rotten and the bridge decking is starting to collapse. These 2 sites are not currently a major source of sediment in the watershed, but the bridges are at high risk of failure due to the decay of the wood. Each abutment is supporting 8 to 10 tons of fill material that would be washed down the creek should they fail.

In the Soup Creek watershed, 5 old crossing sites are at high risk for sediment delivery to Soup Creek. Two of these sites, located in the Soup Creek canyon, consist of dirt fill material over logs spanning the creek. The upper site has approximately 35 tons of fill material placed over the top of the logs, and the lower site has approximately 500 tons of material placed over the top of the logs. These 2 sites may contribute minor amounts of sediment to the stream during high runoff, but these bridges are at high risk of failure due to the decay of the wood. Should either or both of these structures fail, most, if not all, of the 35 tons and 500 tons of material, respectively, would be delivered to the stream. A wooden bridge in the Soup Creek canyon is constructed of log crib abutments and is very decayed. This site was identified in the *Swan Lake*

Water Quality Protection Plan (DEQ, 2005) as a major source of sediment in the Swan Lake watershed due to lack of surface drainage and erosion control on the road surface approaching the bridge. In addition to this finding, the site is at high risk of failure due to decay of the wood on the bridge abutments. Each abutment is supporting 8 to 10 tons of fill material that would be washed down the creek should they fail.

Two additional old bridge sites exist in the lower reaches of the Soup Creek watershed. One is the original Swan Highway bridge site. The deck was removed years ago, but the wooden bridge abutments are still in place and are badly decaying. Each abutment is supporting 8 to 10 tons of fill material that would be washed down the creek should they fail. The other, an old wooden bridge site with no decking, is located on a secondary road off Soup Creek Road. The log stringers and abutments are still in place, but are decaying to the point that the bridge is at high risk of failure. The bridge abutments are supporting 8 to 10 tons of fill material that would be washed down the creek should they fail.

Other sources of sediment delivery found during the inventory are located on sites needing additional erosion control and BMP upgrades. These sites occur on older roads that were constructed before the adoption of forest management BMPs.

Much of the existing road system in the proposed project area meets applicable BMPs. Past project work installed surface drainage on the road systems in the lower portions of the Soup Creek and Cilly Creek watersheds.

- ***WATER YIELD***

According to *ARM 36.11.423*, allowable water-yield increase values were set at levels to ensure compliance with all water-quality standards, protect beneficial uses, and exhibit a low to moderate degree of risk. All allowable water-yield increases in project-area watersheds were set using a low level of risk. This means that the allowable level is a point below where water yields are unlikely to cause any measurable or detectable changes in channel stability. The allowable water-yield increase for the South Fork Lost Creek watershed has been set at 10 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in South Fork Lost Creek reaches the estimated level of 2,626 acres. The allowable water-yield increase for the Cilly Creek watershed has been set at 11 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in Cilly Creek reaches the estimated level of 1,448 acres. The allowable water-yield increase for the Soup Creek watershed has been set at 9 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in Soup Creek reaches an estimated 2,202 acres. Based on review of 1963 aerial photography and DNRC section records in the project area, timber-harvesting and associated road-construction activities have taken place in the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds since the 1950s. These activities, combined with the vegetative recovery that has

occurred, have led to an estimated 1.2-percent water-yield increase over an unharvested condition in the South Fork Lost Creek watershed, 2.3 percent over an unharvested condition in Cilly Creek, and 1.0 percent over an unharvested condition in Soup Creek. *TABLE D-2 – CURRENT WATER-YIELD AND ECA INCREASES IN THREE CREEKS PROJECT AREA* summarizes the existing conditions for water yield in the project area watersheds. Estimated water yield and ECA levels are very low in all 3 watersheds.

ALTERNATIVE EFFECTS

SEDIMENT DELIVERY

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Sediment Delivery***

  No-Action Alternative A would have no direct effects to sediment delivery beyond those currently occurring. Existing sources of sediment, both in channel and out of channel, would continue to recover or degrade based on natural or preexisting conditions.

  Indirect effects of No-Action Alternative A would be an increased risk of sediment delivery to streams from crossings that do not meet applicable BMPs. These sites would continue to pose a risk of sediment delivery to streams until other funding became available to repair them.

- ***Direct and Indirect Effects to Sediment Delivery Common to Action Alternatives B, C, D, and E***

  Each of the proposed action alternatives would replace the wooden bridge over Soup Creek on Soup Creek Canyon Road. Each action alternative would also permanently remove and rehabilitate 2 log-and-earth-fill crossings in the upper reaches of Soup Creek, an old wooden bridge in the lower portion of the Soup Creek watershed, and 2 old wooden bridges on South Fork Lost Creek; the abutments and fill from the original Swan Highway bridge in the lower reaches of Soup Creek would also be permanently removed and rehabilitated.

  Replacement of the existing bridge over Soup Creek on the Soup Creek Canyon Road would involve removal of the log crib walls and the fill material they are currently retaining. The existing structure is beginning to decay and, over time, would become an increasing risk of failure due to decay in the wood. A potential failure of the wood cribbing could allow several tons of sediment to enter the stream. The proposed new bridge would be designed to allow the stream to flow freely through with no constriction of the bank-full channel. This would reduce the potential for bank erosion and channel downcutting that may occur with vertical bridge abutments. The new crossing would also redesign the road approach on the north side of Soup Creek to allow runoff to be diverted from the road surface away from the

TABLE D-2 – CURRENT WATER-YIELD AND ECA INCREASES IN THREE CREEKS PROJECT AREA

	South Fork Lost Creek	Cilly Creek	Soup Creek
Existing % water-yield increase	1.2	2.3	1.0
Allowable % water-yield increase	10	11	9
Existing ECA	310	348	428
Allowable ECA	2,626	1,448	2,202

crossing site in both directions. These improvements would lead to a decrease in delivery of approximately 23.8 tons of sediment per year at this site.

Removal and rehabilitation of the 2 log/earth crossings in the upper Soup Creek canyon would remove 2 potential sources of sediment. As stated above, these 2 sites contain 500 to 600 tons of fill material. Removal of this material and disposal outside of the SMZ would remove the risk of this material being delivered to Soup Creek and Swan River. In the short term, increases in the risk of sediment delivery at rehabilitated sites would increase. This risk would be highest in the year immediately following the rehabilitation activity and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The rehabilitation activity would produce some direct sediment delivery, but this would be minimized through the application of sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a DFWP fisheries biologist.

Removal and rehabilitation of the 2 wooden bridges over South Fork Lost Creek, the existing wooden bridge in the lower Soup Creek watershed, and the existing log cribs and abutments on the old Swan Highway bridge site would remove potential sources of sediment. As stated above, each of these 4 sites contain 16 to 20 tons of fill material (8 to 10 tons behind each abutment). Removal of this material and disposal outside of the SMZ would remove the risk of this material being delivered to Soup Creek and Swan River. In the short term, increases in the risk of sediment delivery at rehabilitated sites would increase. This risk would be highest in the year immediately following the rehabilitation activity and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The rehabilitation activity would produce some direct sediment delivery, but this would be minimized through applying sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a DFWP fisheries biologist.

Where South Fork Lost Creek Road exists very near or within the bankfull channel of South Fork Lost Creek, portions of the road would be permanently closed and rehabilitated. The road would be relocated up the slope, in general keeping the road 200 feet or more away from the stream. No live stream crossings would be required for the new construction, and the old road would be rehabilitated, revegetated, and permanently reclaimed. This would reduce the estimated sediment delivery to South Fork Lost Creek by approximately 18.9 tons per year from the existing condition. In the short term, increases in the risk of sediment delivery at rehabilitated sites would increase. This risk would be highest in the year immediately following the rehabilitation activity and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The rehabilitation activity would produce some direct sediment delivery, but this would be minimized through the application of sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a fisheries biologist from DFWP.

- ***Direct and Indirect Effects to Sediment Delivery Common to Action Alternatives D and E***

Proposed Action Alternatives D and E would each use the existing road system in the Cliff Creek portion of the South Fork Lost watershed. Portions of this road system are

located on FNF-managed land and are part of a FRTA Cost-Share Agreement. This road system crosses Cliff Creek in Section 7 of T24N, R16W, on FNF-managed lands. The stream crossing structure was removed and the site armored with angular rock and vegetation within the last 10 years. This crossing site would require the placement of a temporary bridge for the duration of activities to facilitate access to DNRC-managed lands to the west. No disturbance to existing banks would occur from the placement of the bridge; the structure would span the existing site. Fill material would be placed on the road surface to ramp up to the bridge. This fill would create a risk of sediment delivery to Cliff Creek due to bare soil. This risk would be minimized through the existing vegetation on the site, application of all applicable BMPs, and erosion-control seeding. Upon project completion, the bridge would be removed and the fill material pulled away from the stream. This material would remain on-site and be erosion-control seeded to stabilize bare soil and reduce the risk of erosion and sediment delivery. This would create a short-term increase in the risk of sediment delivery. This risk would be minimized by all applicable BMPs and would decrease within 2 to 3 years to preproject levels as bare soil revegetates.

- ***Direct and Indirect Effects of Action Alternative B to Sediment Delivery***

Several stream crossings would be replaced in the watersheds of the proposed project area and along the proposed haul routes, and erosion control and BMPs would be improved on approximately 47 miles of existing road. This work would:

- decrease the estimated sediment load to South Fork Lost Creek by an additional 0.4 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 19.3 tons of sediment per year;
- reduce the estimated sediment load to Cilly Creek by approximately 1.0 ton per year; and
- reduce the estimated sediment load to Soup Creek by an additional 9.8 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 33.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative B would also construct approximately 13.0 miles of new road and approximately 5.3 miles of temporary road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these

roads are located away from stream crossings. As cutslopes and fillslopes revegetate, this risk would decrease. The installation of surface drainage and the implementation of other BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned road would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative B proposes to replace 3 existing stream crossings in the project area. Two replacements are existing culverts on an unnamed tributary to Soup Creek, and the third is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on the Soup Creek Canyon Road and a new culvert would be required on the following stream crossing sites: two locations along an unnamed tributary to Soup Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and would comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Two new stream crossings proposed with Action Alternative B would be installed in the upper reaches of an unnamed tributary to Soup Creek that flows through Section 22 of the proposed project area. These crossings would be located in deep “v”-shaped valleys with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossings, cutslopes would be much higher than those on standard stream crossings. This type of road construction does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at these sites is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope failures fill and plug the road ditches. With all applicable BMPs in place at these sites, the risk of erosion problems sending sediment to a stream is moderate. This means that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial uses.

Action Alternative B would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, Rules, and applicable

BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas had been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. These activities would follow all requirements of the SMZ Law and Forest Management Rules and would have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

- ***Direct and Indirect Effects of Action Alternative C to Sediment Delivery***

Several stream crossings in the proposed project area watersheds and along the proposed haul route would be replaced, and erosion control and BMPs would be improved on approximately 65 miles of existing road. This work would:

- decrease the estimated sediment load to South Fork Lost Creek by an additional 0.4 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 19.3 tons of sediment per year;
- reduce the estimated sediment load to Cilly Creek by approximately 1.0 ton per year; and
- reduce the estimated sediment load to Soup Creek by an additional 9.8 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 33.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative C would also construct approximately 12.4 miles of new road and approximately 6.9 miles of temporary road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream

crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and the implementation of other BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned road would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative C proposes to replace 3 existing stream crossings in the project area. Two replacements are existing culverts on an unnamed tributary to Soup Creek, and the third is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on Soup Creek Canyon Road, and new culverts would be required on the stream-crossing sites at two locations on an unnamed tributary to Soup Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short-term and comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Two new stream crossings proposed with Action Alternative C would be installed in the upper reaches of an unnamed tributary to Soup Creek flowing through Section 22 of the proposed project area. These crossings would be located in deep “v”-shaped valleys with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossings, cutslopes would be much higher than those on standard stream crossings. This type of road construction does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at these sites is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope failures fill and plug the road ditches. With all applicable BMPs in place at these sites, the risk of erosion problems sending sediment to a stream is moderate. This means that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial use.

Action Alternative C would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, Rules, and applicable BMPs would be applied to all harvesting activities, which would

minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas had been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. These activities would follow all requirements of the SMZ Law and the *Rules*, and would have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

- ***Direct and Indirect Effects of Action Alternative D to Sediment Delivery***

Several stream crossings would be replaced in the proposed project-area watersheds and along the proposed haul route, and erosion control and BMPs would be improved on approximately 84 miles of existing road. This work would create an estimated net increase of 0.6 tons of sediment load to South Fork Lost Creek. This projected increase, when combined with the estimated reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, amounts to:

- a total estimated reduction of approximately 18.7 tons of sediment per year;
- a reduction in the estimated sediment load to Cilly Creek by approximately 0.6 tons per year; and
- a reduction in the estimated sediment load to Soup Creek by an additional 9.8 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D and E*, for a total reduction of approximately 33.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment-delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative D would also construct approximately 16 miles of new road and approximately 4.5 miles of temporary road to access proposed harvest units. The impacts of the proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream

crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and other implementations of BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned roads would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative D proposes to replace 4 existing stream crossings in the project area. Two replacements are existing culverts on an unnamed tributary to Soup Creek, another is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road, and the fourth is an existing culvert on Cliff Creek. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on Soup Creek Canyon Road and new culverts would be required on stream crossing sites at two locations on an unnamed tributary to Soup Creek, and an existing culvert on Cliff Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Two new stream crossings proposed with Action Alternative D would be installed in the upper reaches of an unnamed tributary to Soup Creek that flows through Section 22 of the proposed project area. Action Alternative D also proposes to install a new stream crossing in the upper reaches of Cilly Creek in the eastern portion of Section 14. These crossings would be located in deep “v”-shaped valleys with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossings, cutslopes would be much higher than those on standard stream crossings. This type of road construction does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at these sites is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope sloughs fill and plug the road ditches. With all applicable BMPs in place at these sites, the risk of erosion problems sending sediment to a stream is moderate. This means that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial uses.

Action Alternative D would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, *Rules*, and all applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas had been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. These activities would follow all requirements of the SMZ Law and the *Rules* and have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

- ***Direct and Indirect Effects of Action Alternative E to Sediment Delivery***

Several stream crossings would be replaced in the proposed project area watersheds and along the proposed haul route, and erosion control and BMPs would be improved on approximately 90 miles of existing road. This work would create an estimated net increase of 0.6 tons of sediment load to South Fork Lost Creek. This projected increase when combined with the estimated reduction shown in *Effects Common to Action Alternatives B, C, D, and E* amounts to:

- a total estimated reduction of approximately 18.7 tons of sediment per year;
- a reduction in the estimated sediment load to Cilly Creek by approximately 1.0 ton per year, and a reduction in the estimated sediment load to Soup Creek by an additional 10.1 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 33.9 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment delivery estimates can be found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative E would also construct approximately 7.5 miles of new road and approximately 3 miles of temporary road to access proposed harvest units. The impacts of the proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the

risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and the implementation of other BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned roads would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative E proposes to replace 4 existing stream crossings in the project area. Two replacements are existing culverts on an unnamed tributary to Soup Creek, another is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road, and the fourth is an existing culvert on Cliff Creek. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on Soup Creek Canyon Road and a new culvert would be required on the stream crossing sites at two locations along an unnamed tributary to Soup Creek, and an existing culvert on Cliff Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Action Alternative E would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, *Rules*, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. This harvesting activity would follow all requirements of the SMZ Law and the *Rules* and would have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found

in *APPENDIX E - FISHERIES ANALYSIS*.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Sediment Delivery***

  The cumulative effects would be very similar to those described in the *EXISTING CONDITIONS* portion of this analysis. All existing sources of sediment would continue to recover or degrade as dictated by natural and preexisting conditions until a source of funding became available to repair them. Sediment loads would remain at or near present levels.

- ***Cumulative Effects of Action Alternative B to Sediment Delivery***

  Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. Sediment generated from the replacement of existing culverts would increase the total sediment load in project area streams for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 permit and 3A Authorization. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 0.5 tons of sediment per year in South Fork Lost Creek, a reduction from 2.9 tons per year to approximately 1.9 tons per year in Cilly Creek, and a reduction from 35.6 tons per year to 1.9 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from the replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment-delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. The improved design would reduce the risk of structure failures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

  The construction of new roads and stream crossings and the installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks as described above. In the short term, new road construction and the installation and improvement of surface drainage features would expose bare soil, which would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks is projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term

effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within an SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced down woody material in South Fork Lost, Cilly, and Soup creeks or their tributaries. Tree-retention requirements of the SMZ Law and Forest Management Rules would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative B has a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and Forest Management Rules would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative C to Sediment Delivery***

Cumulative effects would be primarily related to roadwork and stream-crossing replacements. The sediment generated from the replacement of existing culverts would increase the total sediment load in project-area streams for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 permit and 3A Authorization. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 0.5 tons of sediment per year in the South Fork Lost Creek, reduction from 2.9 tons per year to approximately 1.9 tons per year in Cilly Creek, and reduction from 35.6 tons per year to 1.9 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to a better design on the crossings. Improved design would reduce the risk of structure failures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks as described above. In the short term, new road construction and the installation and improvement of surface-drainage features would expose bare soil. This would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable

BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks is projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the expected sediment delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within a SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced down woody material in South Fork Lost, Cilly, and Soup Creek or their tributaries. Tree-retention requirements of the SMZ Law and the Rules would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative C has a low risk of adverse cumulative impacts to sediment yield in project area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and the Rules would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, Rules, and regulations.

- ***Cumulative Effects of Action Alternative D to Sediment Delivery***

Cumulative effects would be primarily related to roadwork and stream-crossing replacements. The sediment generated from the replacement of existing culverts would increase the total sediment load in project-area streams for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 permit and 3A Authorization. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 1.1 tons of sediment per year in South Fork Lost Creek, a reduction from 2.9 tons per year to approximately 2.3 tons per year in Cilly Creek, and a reduction from 35.6 tons per year to 1.9 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment-delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to a better design on the crossings. Improved design would reduce the risk of structure failures, which would reduce the

risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and the installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup Creek as described above. In the short term, new road construction and the installation and improvement of surface-drainage features would expose bare soil, which would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks is projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the expected sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within an SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced down woody material in South Fork Lost, Cilly, and Soup creeks or their tributaries. Tree-retention requirements of the SMZ Law and the Rules would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative D has a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affecting downstream beneficial uses. Implementation of BMPs, the SMZ Law, and the Rules would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative E to Sediment Delivery***

Cumulative effects would be primarily related to roadwork and stream-crossing replacements. The sediment generated from the replacement of existing culverts would increase the total sediment load in project-area streams for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 permit and 3A Authorization. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 1.1 tons of sediment per year in South Fork Lost Creek, a reduction from 2.9 tons per year to approximately 1.9 tons per year in Cilly Creek, and a reduction from 35.6 tons per year to 1.7 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from the replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment delivery estimates is

found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST (CILLY CREEK, SOUP CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. Improved design would reduce the risk of structure failures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and the installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks as described above. In the short term, new road construction and the installation and improvement of surface-drainage features would expose bare soil, which would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks is projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within an SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced down woody material in South Fork Lost, Cilly, and Soup creeks or their tributaries. Tree-retention requirements of the SMZ Law and the *Rules* would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative E has a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and the *Rules* would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, rules, and regulations.

TABLE D-3 – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK WATERSHED

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Existing delivery (tons/year)[1]	19.8	19.8	19.8	19.8	19.8
Estimated reduction[2]	0.0	19.3	19.3	19.3	19.3
Estimated increase[3]	0.0	0.0	0.0	0.6	0.6
Postproject delivery (tons/ year)	19.8	0.5	0.5	1.1	1.1
Reduction (tons/year)[1]	0	19.3	19.3	18.7	18.7
Percent reduction[4]	0	97%	97%	94%	94%

[1]These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.
[2]Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.
[3]Includes projected increases from construction of new roads and new stream crossings.
[4]Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values.

TABLE D-4 – ESTIMATES OF SEDIMENT DELIVERY IN THE CILLY CREEK WATERSHED

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Existing delivery (tons/year)[1]	2.9	2.9	2.9	2.9	2.9
Estimated reduction[2]	0.0	1.4	1.4	1.4	1.4
Estimated increase[3]	0.0	0.4	0.4	0.8	0.4
Postproject delivery (tons/year)	2.9	1.9	1.9	2.3	1.9
Reduction (tons/year)[1]	0	1.0	1.0	0.6	1.0
Percent reduction[4]	0	34%	34%	21%	34%

[1]These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.
[2]Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.
[3]Includes projected increases from construction of new roads and new stream crossings.
[4]Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values.

TABLE D-5 – ESTIMATES OF SEDIMENT DELIVERY IN THE SOUP CREEK WATERSHED

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Existing delivery (tons/year)[1]	35.6	35.6	35.6	35.6	35.6
Estimated reduction[2]	0.0	34.3	34.3	34.3	34.3
Estimated increase[3]	0.0	0.7	0.7	0.7	0.4
Postproject delivery (tons/year)	35.6	2.0	2.0	2.0	1.7
Reduction (tons/year)[3]	0	33.6	33.6	33.6	33.9
Percent reduction[4]	0	95%	95%	95%	95%

[1]These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.
[2]Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.
[3]Includes projected increases from construction of new roads and new stream crossings.
[4]Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values.

WATER YIELD

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Water Yield***

  No-Action Alternative A would have no direct or indirect effects on water yield. Water quantity would not be changed from present levels, and the harvest units would continue to return to fully forested conditions as areas of historic timber-harvests regenerate.

- ***Direct and Indirect Effects of Action Alternative B to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 0.6 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 6.8 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 2.1 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include water yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities; this will be discussed in the *Cumulative Effects* portion of this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams.

- ***Direct and Indirect Effects of Action Alternative C to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 0.5 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 6.4 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 1.5 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include water-yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities and will be discussed later in this analysis. These levels of water-yield increases would produce a low risk of

creating unstable channels in any of the project-area streams.

- ***Direct and Indirect Effects of Action Alternative D to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 1.3 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 9.3 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 1.1 percent over the current level. These levels of projected water-yield increases are incremental values that refer only to water yield generated by this action alternative and do not include water-yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities and will be discussed later in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams.

- ***Direct and Indirect Effects of Action Alternative E to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 1.2 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 9.6 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 0.9 percent over the current level. These levels of projected water-yield increases are incremental values that refer only to water yield generated by this action alternative and do not include water-yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities and will be discussed later in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the streams in the project area.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Water Yield***

  No cumulative effects on water yield would be expected. Existing harvest units would continue to revegetate and move closer to premanagement levels of water use and snowpack distribution.

- ***Cumulative Effects of Action Alternative B on Water Yield***

  The removal of trees proposed in Action Alternative B would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent above unharvested areas to an estimated 1.8 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from this alternative leaves the watershed well below the established threshold of concern established in the *EXISTING CONDITIONS* portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

  The removal of trees proposed in Action Alternative B would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent above unharvested areas to

an estimated 9.1 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed below the established threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Cilly Creek or its tributaries.

The removal of trees proposed in Action Alternative B would increase the water yield in the Soup Creek watershed from its current level of approximately 1.0 percent over unharvested to an estimated 3.1 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed below the established threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative B is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative B to the South Fork Lost Creek and Cilly Creek watersheds and Soup Creek drainage is found in *TABLE D-6 (7, 8) – WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

- ***Cumulative Effects of Action Alternative C on Water Yield***

The removal of trees proposed in Action Alternative C would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent above unharvested acres to an estimated 1.7 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed well below the threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

The removal of trees proposed in Action Alternative C would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent above unharvested acres to an estimated 8.7 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past-management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed below the established threshold of concern established in the existing-conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Cilly Creek or its tributaries.

The removal of trees proposed in Action Alternative C would

increase the water yield in the Soup Creek watershed from its current level of approximately 1.0 percent above unharvested acres to an estimated 2.5 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Soup Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed well below the established threshold of concern established in the existing-conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative C is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative C to the South Fork Lost Creek and Cilly Creek watersheds and the Soup Creek drainage is found in *TABLE D-6 (7, 8) – WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

- ***Cumulative Effects of Action Alternative D on Water Yield***

The removal of trees proposed in Action Alternative D would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent above unharvested acres to an estimated 2.5 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed well below the threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

The removal of trees proposed in Action Alternative D would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent above unharvested acres to an estimated 11.6 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed slightly above the established threshold of concern. It is possible that increases in flow could be observed through the implementation of Action Alternative D. Changes in channel conditions are unlikely, but could occur in individual reaches that have lower channel stability. These changes could include increased streambank erosion, channel down-cutting, and migration of channels away from current locations. Should in-channel erosion occur, deposition of bed and bank material could be deposited in flatter, gentler reaches. Deposition of cobble and gravel material in high enough quantities could lead to additional reaches of Cilly Creek losing surface flow during summer and fall months due to porous bed materials. Another possibility of the projected water-yield increases is that reaches of Cilly Creek that currently have subsurface flow during summer and fall months could have surface flow for a longer period of time

or become perennial due to a higher volume of water available. These projections are unlikely given the channel-stability ratings of Cilly Creek, and Action Alternative D would most likely not have measurable impacts to the stream channel. However, the estimated water-yield increases would leave a low to moderate risk of the described potential negative impacts in the less stable reaches and in isolated instances.

The removal of trees proposed in Action Alternative D would increase water yield in the Soup Creek watershed from its current level of approximately 1.0 percent above unharvested acres to an estimated 2.1 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Soup Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed well below the established threshold of concern established in the *EXISTING CONDITIONS* portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative D is expected to have a low risk of detrimental cumulative impacts due to water-yield increases resulting from the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative D to the South Fork Lost Creek and Cilly Creek watersheds and the Soup Creek drainage is found in *TABLE D-6 (7, 8) – WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

- ***Cumulative Effects of Action Alternative E on Water Yield***

The removal of trees proposed in Action Alternative E would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent above unharvested acres to an estimated 2.4 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from Action Alternative E leaves the watershed well below the threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

The removal of trees proposed in Action Alternative E would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent above unharvested acres to an estimated 11.9 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative E leaves the watershed an estimated 0.9 percent above the established threshold of concern. It is possible that increases in flow could be observed through the implementation of Action Alternative E. Changes in channel conditions are unlikely, but could occur in individual reaches that have lower channel stability.

These changes could include increased streambank erosion, channels down-cutting, and migration of channels away from current locations. Should in-channel erosion occur, deposition of bed and bank material could be deposited in flatter, gentler reaches. Deposition of cobble and gravel material in high enough quantities could lead to additional reaches of Cilly Creek losing surface flow during summer and fall months due to porous bed materials. Another possibility of the projected water-yield increases is that reaches of Cilly Creek that currently have subsurface flow during summer and fall months could have surface flow for a longer period of time or become perennial due to a higher volume of water available. These projections are unlikely given the channel-stability ratings of Cilly Creek, and Action Alternative E would most likely not have measurable impacts to the stream channel. However, the estimated water-yield increases would leave a low to moderate risk of the described potential negative impacts in the less stable reaches and in isolated instances.

The removal of trees proposed in Action Alternative E would increase water yield in the Soup Creek watershed from its current level of approximately 1.0 percent above unharvested acres to an estimated 1.9 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Soup Creek watershed. The water-yield increase expected from Action Alternative E leaves the watershed well below the established threshold of concern established in the *EXISTING CONDITIONS* portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative E is expected to have a low risk of detrimental cumulative impacts due to water-yield increases resulting from the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative E to the South Fork Lost Creek and Cilly Creek watersheds, and the Soup Creek drainage is found in *TABLE D-6 (7, 8) – WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

TABLE D-6 – WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK WATERSHED

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Allowable percent water-yield increase	10%	10%	10%	10%	10%
Percent water-yield increase	1.2	1.8	1.7	2.5	2.4
Acres harvested	0	318	303	512	449
Miles of new road[1]	0	3.6	4.3	4.9	2.9
ECA generated	0	290	262	468	374
Total ECA	310	600	572	778	684
Allowable ECA	2,626	2,626	2,626	2,626	2,626

[1]*Includes only permanent new roads*

TABLE D–7 - WATER YIELD AND ECA INCREASES IN THE CILLY CREEK WATERSHED

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Allowable water-yield increase	11%	11%	11%	11%	11%
Percent water-yield increase	2.3	9.1	8.7	11.6	11.9
Acres harvested	0	896	883	986	1,140
Miles of new road[1]	0	2.3	2.3	5.3	3.8
ECA generated	0	703	691	782	947
Total ECA	348	1,051	1,039	1,130	1,295
Allowable ECA	1,448	1,448	1,448	1,448	1,448

[1]*Includes only permanent new roads*

TABLE D–8 - WATER YIELD AND ECA INCREASES IN THE SOUP CREEK WATERSHED

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Allowable water-yield increase	9%	9%	9%	9%	9%
Percent water-yield increase	1.0	3.1	2.5	2.1	1.9
Acres harvested	0	642	566	443	377
Miles of new road[1]	0	7.1	5.8	5.4	1.5
ECA generated	0	563	500	368	308
Total ECA	428	991	928	796	736
Allowable ECA	2,202	2,202	2,202	2,202	2,202

[1]*Includes only permanent new roads*

APPENDIX E
FISHERIES ANALYSIS

OBJECTIVE

The purpose of this analysis is to assess potential impacts to cold-water fisheries within the Three Creeks Timber Sale Project area as a result of any one of the project alternatives.

INTRODUCTION

The Three Creeks Timber Sale Project area includes State trust lands within Sections 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 22, 24, 25, 26, and 27, T24N, R17W, which all lie entirely within the Swan River drainage (*5th code HUC 17010211030*). Up to 1,999 acres of total harvest area is proposed within the project area.

The project and analysis areas include portions of the watersheds of 3 major tributaries of Swan River. From north to south, these are South Fork Lost, Cilly, and Soup creeks. South Fork Lost, Cilly, and Soup creeks are not identified on the 1996, 2002, or 2004 *Montana 303 (d)* lists as impaired streams.

The Swan River drainage, including South Fork Lost, Cilly, and Soup creeks, and any contributing subbasins, is classified as B-1 in the *Montana Surface Water Quality Standards (ARM 17.30.608[b][i])*. The B-1 classification is for multiple beneficial use waters, including the growth and propagation of cold-water fisheries and associated aquatic life. Among other criteria for B-1 waters, a 1-degree Fahrenheit maximum increase above naturally occurring water temperature is allowed within the range of 32 to 66 degrees Fahrenheit (0 to 18.9 degrees Celsius), and no increases are allowed above naturally occurring concentrations of sediment or suspended sediment that will harm or prove detrimental to fish or wildlife. In regard to sediment, naturally occurring includes conditions or materials present from runoff or percolation from developed land where all reasonable land, soil, and water conservation practices have been applied (*ARM 17.30.603[19*]). Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses (*ARM 17.30.603[24*]). The State has adopted BMPs through its *Nonpoint Source Management Plan* as the principle means of controlling nonpoint source pollution from silvicultural activities (*Thomas et al 1990*).

TABLE OF CONTENTS

Objective	E-1
Introduction	E-1
Species	E-2
Fisheries-Specific Issues Raised During Scoping	E-3
Fisheries Analysis Area	E-3
Analysis Methods and Subissues	E-5
Summary of Alternatives	E-6
Existing Conditions	E-6
South Fork Lost Creek	E-6
Cilly Creek	E-24
Unnamed Creek	E-29
Soup Creek	E-34
Environmental (Alternative) Effects to Fisheries	E-50
Direct and Indirect Effects	E-50
Cumulative Effects	E-91
Specialist Recommendations	E-97
Summary of Anticipated Project-Level Monitoring if an Action Alternative is Selected	E-98

SPECIES

Native cold-water fish species within the project area include bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), slimy sculpin (*Cottus cognatus*), largescale sucker (*Catostomus macrocheilus*), and longnose dace (*Rhinichthys cataractae*). The one nonnative species known to persist within the specific project area is eastern brook trout (*Salvelinus fontinalis*).

Neither slimy sculpin, largescale sucker, nor longnose dace is identified as endangered, threatened, or sensitive species (*MNHP 2004*). Although all 3 species are an integral component of the aquatic ecosystem within the project area, any foreseeable issues or concerns regarding these species' populations or habitats can be addressed through an effects analysis for bull trout and westslope cutthroat trout. Eastern brook trout is an invasive species that is not a component of the region's historical biodiversity, but any foreseeable issues or concerns regarding this species' populations or habitats can also be addressed through an effects analysis for bull trout and westslope cutthroat trout.

Bull trout and westslope cutthroat trout are the primary cold-water species that will be addressed in this analysis. The USFWS has listed bull trout as "threatened" under the *Endangered Species Act*. Both bull trout and westslope cutthroat trout are listed as Class-A Montana Animal Species of Concern. A Class-A designation is defined as a species or subspecies that has limited numbers and/or habitats both in Montana and elsewhere in North America, and elimination from Montana would be a significant loss to the gene pool of the species or subspecies (DFWP, MNHP, and *Montana Chapter American Fisheries Society Rankings*). DNRC has also identified bull trout and westslope cutthroat trout as sensitive species *(Administrative Rule of Montana [ARM] 36.11.436)*.

Both bull trout and westslope cutthroat trout exhibit resident, fluvial, and adfluvial life forms. Resident life forms spend their juvenile and adult life in natal or nearby low-order tributaries. Fluvial and adfluvial life forms generally leave their natal streams within 1 to 3 years of emergence (*Shepard et al 1984, Fraley and Shepard 1989*) to mature in downstream river and lake systems, respectively, and then return again to headwater or upstream reaches to spawn. Fluvial and adfluvial life forms of bull trout and westslope cutthroat trout are typically larger than resident fish, and bull trout have been observed returning to upstream reaches during successive or alternating years to spawn (*Fraley and Shepard 1989*). Overall, the life forms and stages of bull trout and westslope cutthroat trout have evolved to exist in sympatry (*Nakano et al 1992, Pratt 1984, Shepard et al 1984*).

Fluvial and adfluvial bull trout generally mature at ages 5 to 6, begin upstream spawning migrations in April, and spawn between September and October in response to a temperature regime decline below 9 to 10 degrees Celsius (*Fraley and Shepard 1989*). Spawning adult bull trout are known to construct redds in close association with upwelling groundwater and proximity to overhanging or instream cover (*Fraley and Shepard 1989*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to bull trout embryo and juvenile survival (*MBTSG 1998, Weaver and Fraley 1991, Pratt 1984*).

Resident westslope cutthroat trout have been observed maturing at ages 3 to 5 (*Downs et al 1997*), and all life forms are known to spawn during

May through June (*Shepard et al 1984*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to westslope cutthroat trout embryo and juvenile survival (*Pratt 1984*).

FISHERIES-SPECIFIC ISSUES RAISED DURING SCOPING

Issues, in respect to this environmental analysis, are not specifically defined by either MEPA or the Council on Environmental Quality. For the purposes of this environmental analysis, issues will be considered actual or perceived effects, risks, or hazards as a result of the proposed alternatives.

Fifteen written concerns and issues regarding fisheries resources were raised through public participation during the scoping process. These concerns and issues are contained in a separate document (*Public Comments to Scoping of Proposed Three Creeks Timber Sale Project – Fisheries-Related Comments*) that can be found in the project file. Each concern and issue is identified and followed with a statement describing how the concern or issue will be addressed by this analysis.

The issues raised both internally and through public comment during the scoping process are: the proposed actions may adversely affect fisheries populations and fisheries habitat features, including flow regime, sediment, channel forms, riparian function, large woody debris, stream temperature, and connectivity, in fish-bearing streams within the project area. These issues will be addressed under *EXISTING CONDITIONS* and *ENVIRONMENTAL EFFECTS*.

FISHERIES ANALYSIS AREA

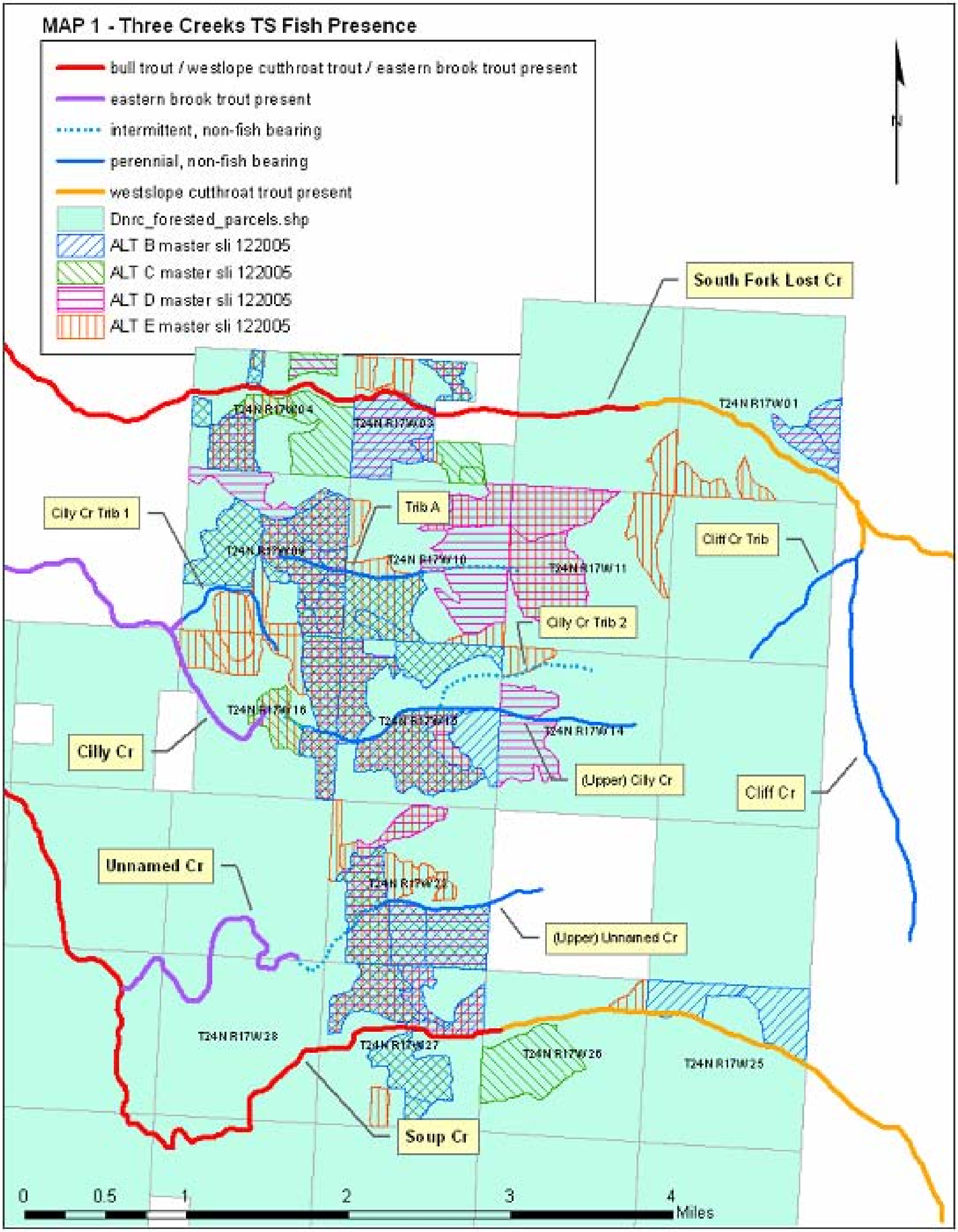
The general fisheries analysis area includes those streams within and approximal to the project area. The project and analysis area include portions of the watersheds of 3 major tributaries of Swan River. From north to south, these are South Fork Lost, Cilly, and Soup creeks. The detailed fisheries analysis of potential direct, indirect, and cumulative effects will focus on the fish-bearing portions of South Fork Lost, Cilly, Unnamed, and Soup creeks. Unnamed Creek, a tributary to Soup Creek, will be separately analyzed in detail in order to better address specific fisheries issues in that stream. The fish-bearing reaches of South Fork Lost, Cilly, Unnamed, and Soup creeks within and adjacent to protect area were chosen for detailed analysis since the proposed actions may have foreseeable measurable or detectable adverse impacts to corresponding fish habitats.

The downstream reaches of Swan River and Lost Creek are not within the project area and will not be included in the analysis portion of the direct and indirect effects in this resource appendix. With respect to downstream fisheries, no project alternatives are expected to have measurable or detectable direct or indirect effects in the downstream reaches of Swan River and Lost Creek. Both Swan River and Lost Creek will be included in the cumulative effects analysis as deemed applicable.

All potential fish-bearing streams within and immediately adjacent to the project area were surveyed during 2003, 2004, and 2005 for fisheries presence (see *FIGURE 1 – THREE CREEK TIMBER SALE PROJECT FISH PRESENCE*). Streams that were surveyed for fish presence and determined not to contain fish populations or provide fish habitat are considered non-fish bearing. Non-fish-bearing stream reaches are not individually addressed in this fisheries analysis and include:

- Tributary A - Field surveys indicate that the isolated, disconnected perennial reach of this stream is non-fish-bearing.

FIGURE E-1 – THREE CREEKS TIMBER SALE PROJECT FISH PRESENCE



- Cilly Creek Tributary 1 - Field surveys indicate that this tributary (except for the lowest approximately 200-foot reach of the tributary immediately upstream of Cilly Creek) does not provide fish habitat. The lowest approximately 200-foot reach provides marginal habitat for eastern brook trout.
- Cilly Creek Tributary 2 - Field surveys indicate that this tributary does not provide fish habitat.
- (Upper) Cilly Creek - Field surveys indicate that the isolated, disconnected perennial reach of this stream is non-fish-bearing.
- Cliff Creek - The lower 780 feet of this stream provides marginal habitat to westslope cutthroat trout, but this stream is outside of the project area.
- Cliff Creek Tributary - Field surveys indicate that the lower reach of this stream is a migration barrier and the upper reach is non-fish-bearing.
- (Upper) Unnamed Creek - Field surveys indicate that the isolated, disconnected perennial reach of this stream is non-fish-bearing.

The streams bulleted above are excluded from the specific, detailed analysis. However, these streams may be included as part of the *EXISTING CONDITIONS, ENVIRONMENTAL EFFECTS,* and *SPECIALIST RECOMMENDATIONS FOR SOUTH FORK LOST, CILLY, UNNAMED, AND SOUP CREEKS*.

ANALYSIS METHODS AND SUBISSUES

The existing conditions of bull trout and westslope cutthroat trout populations and habitat will be described under *EXISTING CONDITIONS* of this analysis. *ENVIRONMENTAL (ALTERNATIVE) EFFECTS* will compare those existing conditions to the anticipated effects of the project alternatives to determine foreseeable impacts to bull trout and westslope cutthroat trout.

Analysis methods are a function of the types and quality of data available for analysis, which varies among the different watersheds in the project area. The analyses may either be quantitative or qualitative. The best available data for both populations and habitats will be presented separately for South Fork Lost, Cilly, Unnamed, and Soup creeks. Existing conditions and foreseeable environmental effects for South Fork Lost and Soup creeks will be explored using the following outline of subissues:

- Populations – Presence and Genetics
- Habitat – Flow Regimes
- Habitat – Sediment
- Habitat – Channel Forms
- Habitat – Riparian Function
- Habitat – Large Woody Debris
- Habitat – Stream Temperature
- Habitat – Connectivity
- Existing Collective Impacts and Cumulative Effects

Existing conditions and foreseeable environmental effects for Cilly and Unnamed creeks will be explored using a simplified set of accounts, which do include the more detailed outline of subissues. Where data is available regarding each subissue, that information will be described for Cilly and Unnamed creeks in the simplified accounts.

Existing road density and road-stream crossing density are other variables that have been indirectly correlated to native fisheries population trends across large regional areas (*Quigley and Arbelbide 1997*). The mechanisms through which road density and road-stream crossing density affect native fisheries populations include sedimentation, fishing access, poaching, recreational access, timber harvest access, and grazing

and agriculture (*Quigley and Arbelbide 1997, Baxter et al 1999*). As road density and road-stream crossing density are, therefore, very broad surrogates of multiple potential actions, these variables are tools to describe potential cumulative effects to fisheries. In the absence of site-specific fisheries data to describe the existing conditions of the project area, road density and road-stream crossing density could be considered simple, viable measures of potential cumulative effects. However, the level of detailed, project-specific fisheries population and habitat data to be utilized throughout this analysis is expected to provide a much more accurate and precise baseline for the cumulative-effects analysis of fisheries in the project area. Therefore, road density and road-stream crossing density will not be used as a measure of potential cumulative effects in this analysis.

SUMMARY OF ALTERNATIVES

See *CHAPTER II – ALTERNATIVES* in the *DEIS and FEIS of THREE CREEKS TIMBER SALE PROJECT* for detailed information, specific mitigations, and road-management plans pertaining to No-Action Alternative A and Action Alternatives B, C, D, and E.

- ***No-Action Alternative A***

  Existing conditions relative to bull trout and westslope cutthroat trout in the project area would remain unchanged as a result of the selection of this alternative.

- ***Action Alternative B***

  Approximately 1,884 acres involving 34 proposed units would be harvested using various silviculture plans.

- ***Action Alternative C***

  Approximately 1,787 acres involving 33 proposed units would be harvested using various silviculture plans.

- ***Action Alternative D***

  Approximately 1,970 acres involving 33 proposed units would be harvested using various silviculture plans.

- ***Action Alternative E***

  Approximately 1,999 acres involving 49 proposed units would be harvested using various silviculture plans.

Actions associated with Action Alternatives B, C, D, and E, including associated road construction and maintenance, would occur in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds, all of which provide varying degrees of bull trout and westslope cutthroat trout habitat.

EXISTING CONDITIONS

A very low impact means that the impact is unlikely to be detectable or measurable, and the impact is not likely to be detrimental to the resource. A low impact means that the impact is likely to be detectable or measurable, but the impact is not likely to be detrimental to the resource. A moderate impact means that the impact is likely to be detectable or measurable, but the impact may or may not (50/50) be detrimental to the resource. A high impact means that the impact is likely to be detectable or measurable, and the impact is likely to be detrimental to the resource.

➢ ***SOUTH FORK LOST CREEK***

South Fork Lost Creek is a third-order stream and the entire reach within the project area is considered fish-bearing.

♦ **South Fork Lost Creek Populations – Presence and Genetics**

The South Fork Lost Creek watershed has been identified as a core habitat area within the Swan River drainage bull trout

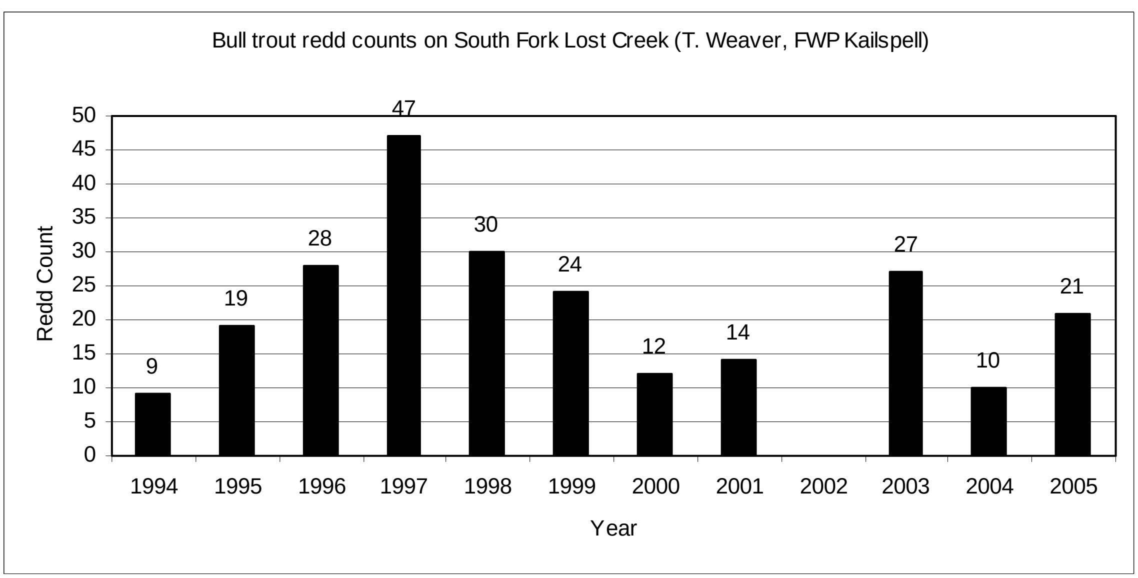
conservation area (*MBTSG 1996, MBTRT 2000*). Core areas are watersheds, including tributary drainages and adjoining uplands, used by migratory bull trout for spawning and early rearing, and by resident bull trout for all life history requirements (*MBTRT 2000*). Although bull trout may exhibit the resident life form in South Fork Lost Creek, this stream is used by bull trout primarily as spawning and rearing habitat for adfluvial populations associated with Swan Lake. South Fork Lost Creek supports westslope cutthroat trout exhibiting adfluvial, fluvial, and resident life forms.

Genetic data suggests that migratory bull trout adults in the upper Flathead River system have been found to frequently return to their natal or near-natal streams (*Kanda et al 1997*), and populations of migratory spawning bull trout in the Flathead River system have been observed returning to the same stream reaches during subsequent spawning runs (*Fraley and Shepard 1989*). This propensity for habitual adult migration to natal or near-natal streams and the consequent selection of unique spawning locations would make the use of redd counts in South Fork Lost Creek a useful measure of overall bull trout success in occupying this specific subbasin. Similarly, westslope cutthroat trout redd counts would be expected to express that species' overall success in occupying spawning and rearing habitats provided by South Fork Lost Creek.

The protocol for collecting redd count data in South Fork Lost Creek is described in *Weaver and Fraley (1991)*. Experienced crews and fixed survey reaches are used for result consistency.

TABLE E-1 – BULL TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2005 shows that the number of bull trout redds constructed in the South Fork Lost Creek reference reach has ranged from 9 to 47 during the years 1994 to 2005. The data is insufficient to describe a trend in bull trout redd counts with a high degree of certainty. An

TABLE E-1 – BULL TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2005



analysis of bull trout redd counts from throughout the Swan River drainage suggests that the larger bull trout population may be increasing (*Rieman and Myers 1997*), but the same study also indicates that a larger data set than that provided in this table is likely needed in order to begin identifying long-term trends of bull trout populations in individual streams. However, *Weaver (2005)* has indicated that the existing Swan River drainage bull trout population appears to be stable, and redd counts from South Fork Lost and Soup creeks are generally representative of trends in other bull trout spawning streams within the drainage. *Weaver (2005)* noted that increases in bull trout redd counts from 1996 through 2000 may have been due to a strong bull trout population response to *Mysis* shrimp densities in Swan Lake. (*Mysis* is an introduced macroinvertebrate to Swan Lake that has contributed to the food base of adfluvial bull trout and westslope cutthroat trout.)

TABLE E-2 – WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2004 shows that the number of westslope cutthroat trout redds constructed in the South Fork Lost Creek reference reach has ranged from 7 to 26 during the years 1994 to 2004. Although the data is insufficient to describe a trend in westslope cutthroat trout redd counts with a high degree of certainty, this data is likely indicative of a generally stable westslope cutthroat trout population associated with the South Fork Lost Creek drainage.

Leathe et al (1985) describes bull trout and westslope cutthroat trout population densities in 2 different reaches of South Fork Lost Creek as ranging from low to moderate (see *TABLE E-3 – SPECIES DENSITIES IN SOUTH FORK LOST CREEK, 1982 THROUGH 1983 [LEATHE ET AL 1985])*. Reach 1 starts at the confluence of North Fork Lost and South Fork Lost creeks and extends upstream to river mile 1.86. Reach 2 includes

TABLE E-2 – WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2004

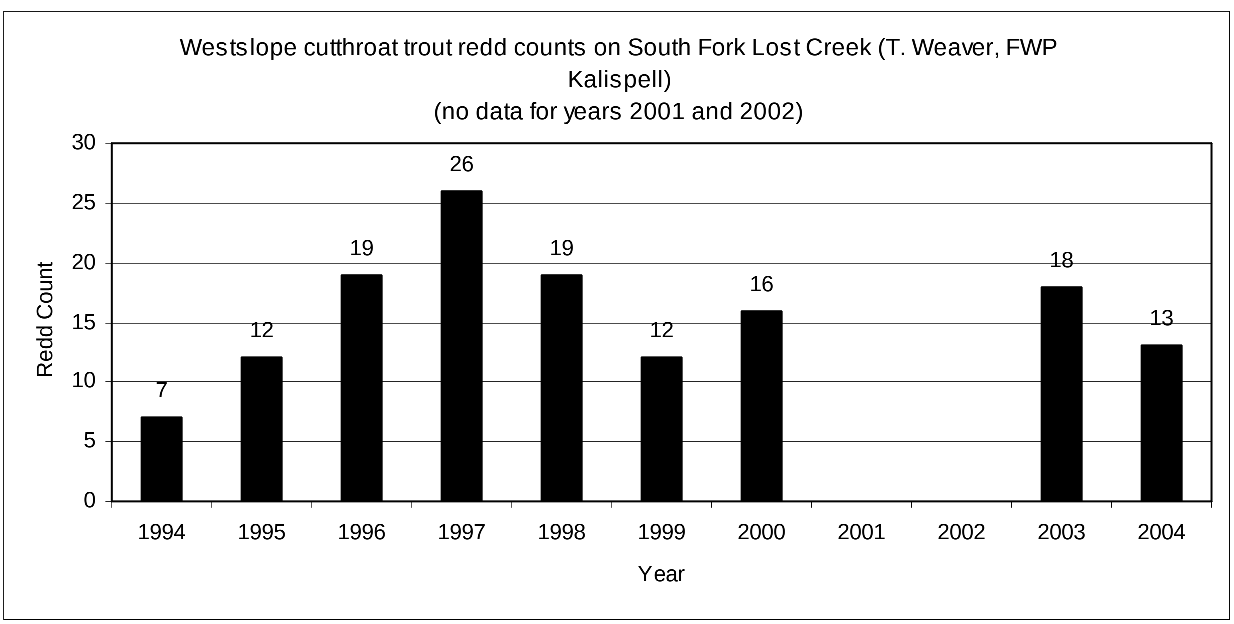


TABLE E-3 – SPECIES DENSITIES IN SOUTH FORK LOST CREEK, 1982 THROUGH 1983 (LEATHE ET AL 1985)

REACH/YEAR SURVEYED	NUMBER OF FISH GREATER THAN 75 MILLIMETERS PER 300 METERS			NUMBER OF FISH GREATER THAN 150 MILLIMETERS PER 300 METERS		
	BULL TROUT	WESTSLOPE CUTTHROAT TROUT	EASTERN BROOK TROUT	BULL TROUT	WESTSLOPE CUTTHROAT TROUT	EASTERN BROOK TROUT
1/1983	24 ('low')	36 ('low')	93 ('mod')	5 ('low')	16 ('low')	11 ('low')
2/1982	99 ('mod')	23 ('low')	0	12 ('low')	12 ('low')	0

that portion of South Fork Lost Creek from river miles 1.86 to 6.21.

Independent of the current population status, present are considerable existing and future risks to both bull trout and westslope cutthroat trout populations and genetics in South Fork Lost Creek and throughout the Swan River drainage. Perhaps the greatest future threats to bull trout in the Swan River drainage are from the introduction and spread of nonnative fish (*MBTSG 1996*). The recently confirmed introduction and reproduction of lake trout (*Salvelinus namaycush*) in Swan Lake is expected to have some level of acute negative effect to bull trout within the Swan River drainage. Lake trout will likely have a negative effect on bull trout populations in Swan Lake through the predation of juvenile and subadult life stages and niche displacement. These foreseeable interactions will likely be expressed through lower rates of bull trout redd count construction in South Fork Lost Creek.

Bull trout are also negatively affected by nonnative eastern brook trout primarily through hybridization and, to some extent, by the displacement of juvenile fish in rearing habitats. Data suggests that bull trout and eastern brook trout hybridization has occurred throughout the Swan River drainage (*Kanda et al 1997*).

Although samples from South Fork Lost Creek in 1993 (*MFISH 2005*) show that 100-percent genetically pure bull trout may exist in the stream, that particular sample set may not have conclusively ruled out hybridization in South Fork Lost Creek at that time (*Kanda et al 1997*). *Weaver (2005)* has noted that bull trout x eastern brook trout hybrids are occasionally captured during sampling efforts in South Fork Lost Creek. Several factors point toward hybridization as a lower overall risk to bull trout than that of displacement by lake trout: migratory bull trout tend to have a reproductive size advantage over resident eastern brook trout (*Rieman and McIntyre 1993*), and offspring can have a considerable chance of being sterile or exhibiting other progressive growth problems (*Leary et al 1983*).

Westslope cutthroat trout also face considerable threats from the introduction and spread of nonnative fish. Introgression from hybridization with rainbow trout (*Oncorhynchus mykiss*) and other cutthroat trout subspecies may pose the foremost risk to westslope cutthroat trout in Montana (*Liknes and Graham 1988*). Westslope cutthroat trout within South Fork Lost Creek below the migration-barrier falls at river mile 4.94 are known to exhibit levels of genetic purity between 75 and 90 percent (*NRIS 2004*). Westslope cutthroat trout upstream of the migration barrier falls are

potentially 100-percent genetically pure (*NRIS 2004*). Westslope cutthroat trout are susceptible to displacement by introduced salmonids, especially eastern brook trout; however, the variable mechanisms through which this occurs are not well understood (*Griffith 1988*).

Existing impacts to bull trout and westslope cutthroat trout populations and genetics in South Fork Lost Creek are due primarily to the introduction of nonnative salmonids. Existing impacts to bull trout in South Fork Lost Creek include an imminent moderate to high impact due to the propagation of lake trout in the drainage and a low to moderate impact due to hybridization with eastern brook trout. Existing impacts to westslope cutthroat trout include a moderate impact due to introgression from rainbow trout hybridization and a low to moderate impact from displacement by eastern brook trout (where the 2 species' distributions overlap below the migration-barrier falls).

- **South Fork Lost Creek Habitat – Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS* .) The analysis of hydrologic data for South Fork Lost Creek indicates that the existing average departure in flow regime is approximately 1.2 percent above the range of naturally occurring conditions (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest-crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

Changes in flow regime can affect bull trout and westslope cutthroat trout fisheries through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish habitat variables. As a consequence, the likelihood is very low for very low existing direct and indirect impacts to these habitat characteristics as a result of the estimated 1.2-percent increase in flow regime to South Fork Lost Creek within the project area.

Changes in flow regime have been known to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, the likelihood is very low for very low existing direct and indirect impacts to native and nonnative fish species as a result of modifications of flow regimes South Fork Lost Creek within the project area.

- **South Fork Lost Creek Habitat – Sediment**

The existing stream sediment processes of South Fork Lost Creek are described using the *Rosgen* stream morphological type, several different sediment

composition surveys, and streambank stability. The stream morphology of 5 separate reaches of South Fork Lost Creek within the project area (see following *FIGURE E-2 – SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEK TIMBER SALE PROJECT AREA*) is described using the *Rosgen* river classification (*Rosgen 1996*). From the confluence with North Fork Lost Creek (river mile 0.00) upstream to river mile 1.76 (Reach 1), the creek exhibits a 'C3' channel type; from river mile 1.76 to 3.42 (Reach 2), the creek exhibits a 'B3' channel type; from river mile 3.42 to 4.22 (Reach 3), the creek exhibits a 'C3' channel type; from river mile 4.22 to 4.94 (Reach 4), the creek exhibits a 'B3a' channel type; and from river mile 4.94 upstream to the USFS property boundary at river mile 6.27 (Reach 5), the creek exhibits a 'B3' channel type. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B3 morphological type is characteristic of channel compositions dominated by cobbles and codominated by boulders with lesser amounts of gravel and sand (*Rosgen 1996*). The C morphological type broadly includes meandering streams with both riffles and pools in low gradient, broad, alluvial valley bottoms (*Rosgen 1996*). More specifically, the C3 morphological type is indicative of cobble-dominated systems with well-developed floodplains.

Several surveys have been conducted to describe the sediment composition of South Fork Lost Creek, including *McNeil* core, substrate score, and *Wolman* pebble count. The *McNeil* core sampling methodology (*McNeil and Ahnell 1964*) has been demonstrated to be an effective technique for measuring temporal changes in the streambed permeability of spawning gravels. *McNeil* core data has been collected in South Fork Lost Creek in a known bull trout spawning reach in the NE1/4SE1/4 of Section 3, T24N, R17W, between 1994 and 2005 (see *TABLE E-4 – MCNEIL CORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005*). *Weaver and Fraley (1991)* found that the percentage of substrates less than 6.35 millimeters in spawning beds was inversely proportional to bull trout and westslope cutthroat trout embryo survival in the Flathead River basin. The *Flathead Basin Commission (FBC)*, a cooperative program involving private, State, and Federal landowners in the river basin, subsequently determined that streams with spawning gravels having 35 or 40 percent of substrates less than 6.35 millimeters in any given year were "threatened" or "impaired", respectively, in regards to bull trout and westslope cutthroat trout embryo survival (*FBC 1991*). *McNeil* core sample results from South Fork Lost Creek are collected using *Weaver and Fraley (1991)* and displayed to show the proportion of substrates less than 6.35 millimeters in size. The sample sets show that the proportion of substrates less than 6.35 millimeters is under the 35-percent threshold for "threatened" status.

Embeddedness is generally described as the degree to which fine sediments surround coarse substrates on the streambed surface (*Sylte and Fischenich 2002*). The substrate score is one technique for measuring

FIGURE E-2 –SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA

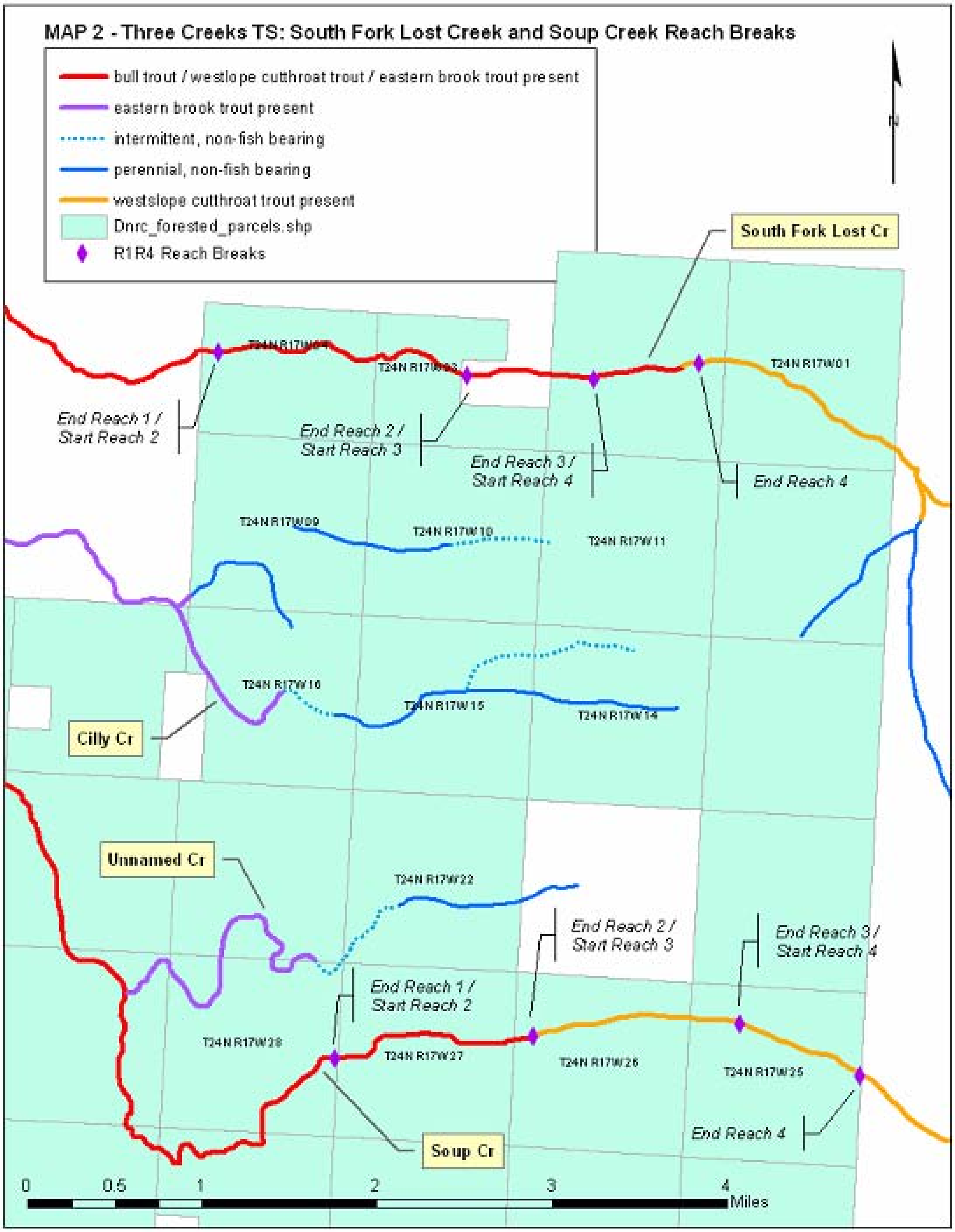
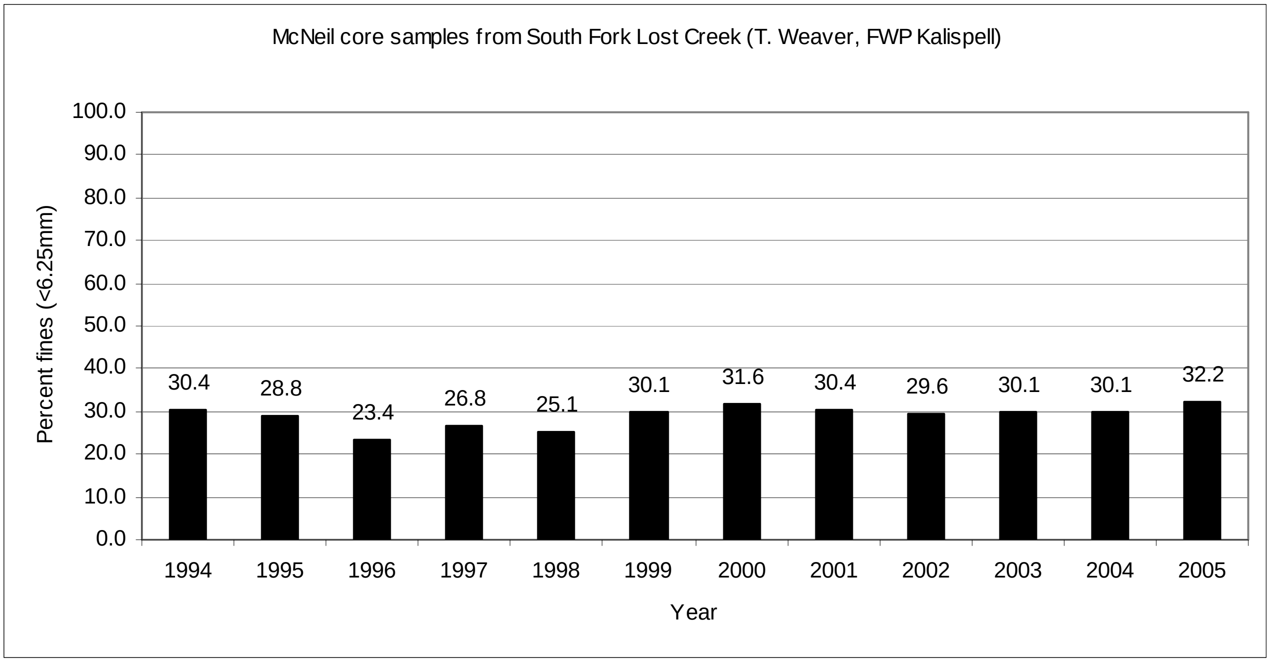
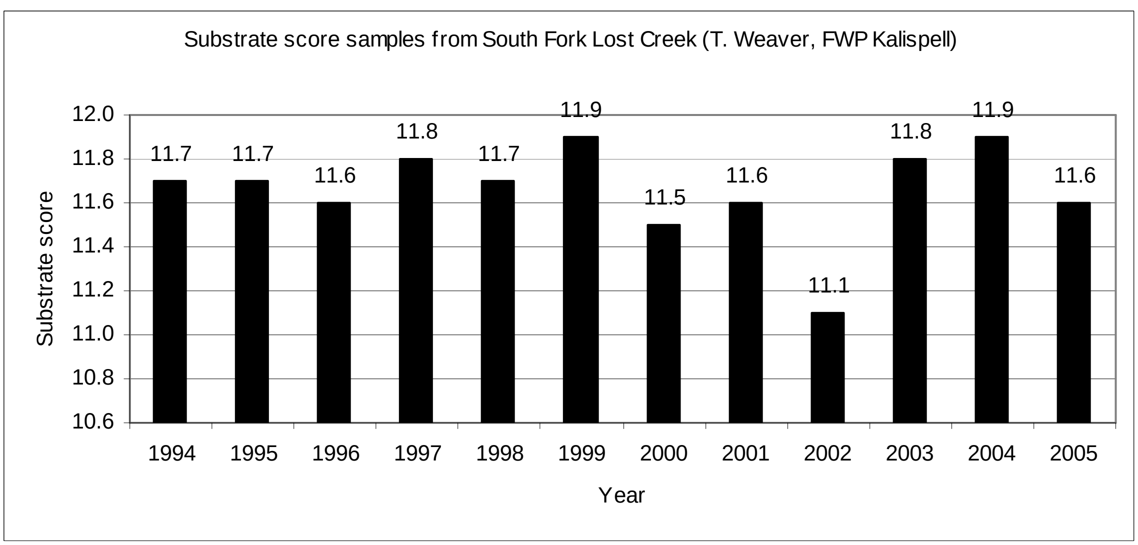


TABLE E-4 – MCNEIL CORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005



embeddedness, where higher scores indicate lower embeddedness and typically better juvenile bull trout habitat (*Shepard et al 1984*). A modified substrate score methodology (*Weaver and Fraley 1991 citing others*) has been employed on South Fork Lost Creek from 1994 through 2005 (see *TABLE E-5 – SUBSTRATE SCORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005*) in a known juvenile bull trout rearing reach (NW1/4SW1/4 of Section 4, T24N, R17W). The Flathead Basin Commission (FBC) has subsequently determined that streams with substrate scores less than 10 or 9 in any give year were “threatened” or “impaired”, respectively, in regards to bull trout and westslope cutthroat trout embryo

TABLE E-5 – SUBSTRATE SCORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005



survival and juvenile rearing habitat (*FBC 1991*). The sample sets show substrate scores higher than 10, which indicate low levels of embeddedness.

The *Wolman* pebble count (*Wolman 1954*) is another method that can be used to describe temporal changes in substrate size classes on the streambed surface. Sample data from Reaches 1 through 4 on South Fork Lost Creek (see *FIGURE E-2 – SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA)* is available from 2002 (see *TABLE E-6 – WOLMAN PEBBLE COUNT RESULTS FROM SOUTH FORK LOST CREEK, 2002*). Considering Reaches 1 through 4, the maximum combined percentage of substrates less than 8 millimeters is 9.6 percent (Reach 4), which is considerably lower than the results calculated for the similar size class in the *McNeil* core samples (percentage of substrate less than 6.35 millimeters ranges from 23.4 percent to 31.6 percent). This difference suggests that there could be a greater level of interstitial spaces in the streambed surface (cobble) substrates than may be indicated by the *McNeil* core data.

The final assessment of stream sediment processes includes a description of streambank stability. Streambank stability is a measure of bank erosion rates per stream length, and changes in the rates can be used as one indicator of potential existing impacts to fish habitats. Streambank stability data for South Fork Lost Creek is available for the year 2002 (see *TABLE E-7 – STREAMBANK STABILITY RESULTS FROM SOUTH FORK LOST CREEK [KOOPAL 2002A]*) and includes all stream habitats from the confluence with North Fork Lost Creek (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 4.94) (see *FIGURE E-2 – SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA*). The protocol used for collecting the streambank stability data is that outlined in *Overton et al*

TABLE E-6 – WOLMAN PEBBLE COUNT RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002A)

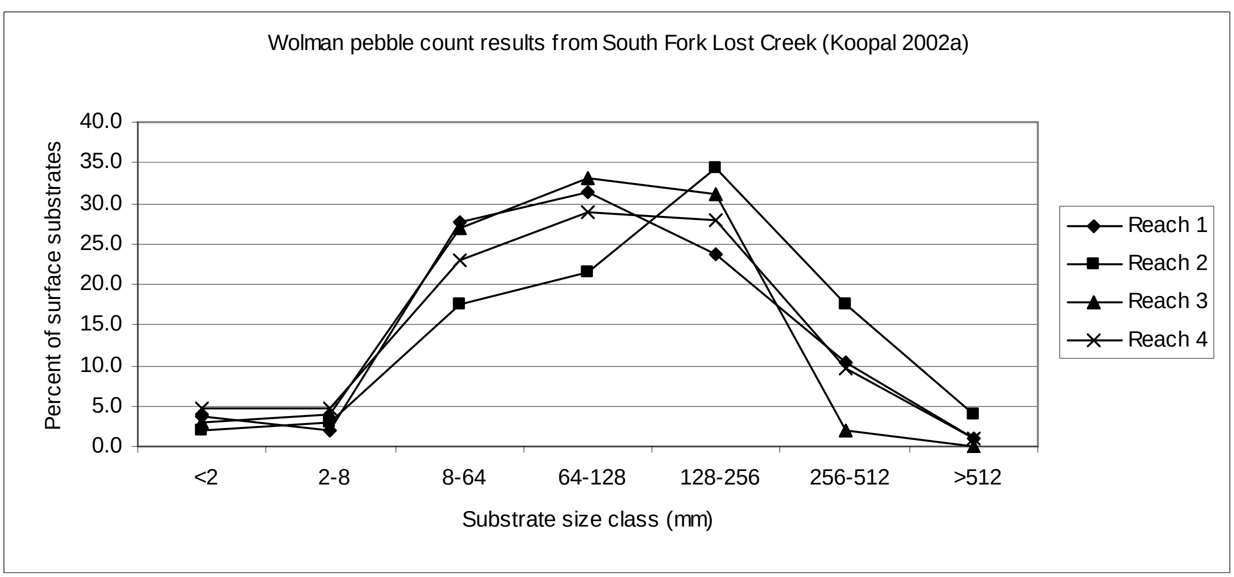


TABLE E-7 – STREAMBANK STABILITY RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002A)

REACH	**BANK LENGTH (FEET)**		**PERCENT STABLE BANK**	**PERCENT UNSTABLE BANK**	**PERCENT UNDERCUT BANK**
	LEFT	**RIGHT**	**MEAN**	**MEAN**	**MEAN**
1	9,355.0	9,346.0	99.89	0.11	2.13
2	8,794.0	9,164.0	100.00	0.00	1.36
3	4,232.0	4,229.0	98.61	1.39	2.05
4	3,888.0	3,892.0	100.00	0.00	0.84

(1997). Overall, the results of this data set show very high levels (98.61 to 100.00 percent) of streambank stability through Reaches 1 to 4 in the project area. Quantitative data of streambank stability is not available for Reach 5, but qualitative field reviews of the reach have also revealed very high levels of streambank stability.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the South Fork Lost Creek drainage are considered an unspecified, collective effect. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of *EXISTING CONDITIONS* in this analysis.)

McNeil core data indicates that the substrates of known spawning reaches are not "threatened", substrate scores describing streambed substrate embeddedness also indicate that known bull trout rearing habitat is not "threatened", and Wolman pebble counts suggest that high levels of streambed substrates are in the gravel, cobble, and boulder classes. Additionally, a recent streambank-stability assessment shows very low levels of potential streambank erosion, a natural source of sedimentation. Based on these observations, no direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat likely exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Channel Forms**

Two descriptions of channel formation will also be used to describe existing bull trout and westslope cutthroat trout habitat in South Fork Lost Creek: *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory (Overton et al 1997)*. The stream gradient of Reaches 1 and 3 (see *FIGURE E-2 – SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA*) primarily ranges from 1 to 3 percent, and the stream gradient of Reaches 2 and 4 primarily ranges from 3 to 7 percent. The stream formations of South Fork Lost Creek are broadly described as exhibiting 'forced pool-riffle', 'forced step-pool', and 'plane bed' *Montgomery/ Buffington* classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). 'Forced step-pool' channel forms are also generally a function of large-woody-debris recruitment to the bankfull area

of the stream, and the channel form typically has pool frequencies of 1:1 to 1:4 and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*).

The *R1/R4 Fish Habitat Standard Inventory* is a useful protocol for describing detailed existing conditions and tracking temporal changes in the relative proportions of different stream microhabitats used by bull trout, westslope cutthroat trout, and other native fisheries. Inventory data for South Fork Lost Creek is available for the year 2002 (see *TABLE E-8 – R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUTH FORK LOST CREEK [KOOPAL 2002A]*) and includes all stream habitats from the confluence with North Fork Lost Creek (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 4.94) (see *FIGURE E-2 – SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA]*). In order to simplify the description of existing conditions, detailed habitat data from Reaches 1 through 4 has been consolidated into fast and slow habitat types. Fast habitats include stream features such as cascades, high and low gradient riffles, runs, and glides. Slow habitats include dammed pools, lateral scour pools, midchannel scour pools, plunge pools, and step pools. Bull trout and westslope cutthroat trout utilize all of the habitat types with varying frequency throughout the different life stages, although long-term persistence within a stream by all life stages of each species is generally limited by the amount and frequency of different slow habitat types. Increasing amounts of different pool habitats are typically proportional to increasing levels of bull trout and westslope cutthroat trout stream habitat quality.

The following existing conditions can be deduced from the 2002 habitat inventory:

– The habitat data for Reach 1 indicates that 78 percent of all channel forms are fast-type habitat features, and the remaining 22 percent of all channel forms are slow-type habitat features; approximately 7 percent of the

TABLE E-8 – R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002A)

REACH	HABITAT TYPE	TOTAL NUMBER OF UNITS	MEAN HABITAT LENGTH (FEET)	MEAN WIDTH (FEET)	MEAN HABITAT DEPTH (FEET)	MEAN WIDTH/ DEPTH RATIO	MEAN HABITAT AREA (SQUARE FEET)	MEAN HABITAT VOLUME (CUBIC FEET)
1	Fast	70	122.8	19.4	0.38	53.34	2,385.8	901.4
1	Slow	20	33.4	19.4	1.17	17.84	649.5	759.3
2	Fast	76	95.9	18.6	0.38	50.54	1,782.6	683.3
2	Slow	41	36.0	21.0	1.15	20.40	755.9	866.3
3	Fast	35	91.3	16.2	0.31	55.65	1,481.5	461.9
3	Slow	22	47.3	17.7	1.08	18.21	838.1	907.3
4	Fast	25	122.6	16.6	0.35	48.12	2,031.1	714.2
4	Slow	19	37.5	18.0	1.31	15.50	674.5	881.8

total reach area includes slow-type habitat features, and approximately 19 percent of the total reach volume is in slow-type habitat features.

- The habitat data for Reach 2 indicates that 65 percent of all channel forms are fast-type habitat features, and the remaining 35 percent of all channel forms are slow-type habitat features; approximately 19 percent of the total reach area includes slow-type habitat features, and approximately 41 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 3 indicates that 61 percent of all channel forms are fast-type habitat features, and the remaining 39 percent of all channel forms are slow-type habitat features; approximately 26 percent of the total reach area includes slow-type habitat features, and approximately 55 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 4 indicates that 57 percent of all channel forms are fast-type habitat features, and the remaining 43 percent of all channel forms are slow-type habitat features; approximately 20 percent of the total reach area includes slow-type habitat features, and approximately 48 percent of the total reach volume is in slow-type habitat features.

This information portrays Reach 1 as having a relatively low proportion of slow, or pool, habitat features, and Reaches 2 through 4 are described as having relatively higher proportions of pool-habitat features. It can also be inferred that Reaches 2 through 4 have relatively higher levels of channel complexity, in-stream cover, and potential wintering habitat. Considering reach gradients, valley location, and geomorphological processes, the observed proportions of habitat types for each reach are within the broad ranges of expected conditions.

No specific conclusions regarding trends in channel form can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing specific trends in channel forms, no direct and indirect impacts to the channel form component of bull trout and westslope cutthroat trout habitat are apparent in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream nutrient inputs, and other variables (*Hansen et al 1995*). This section will consider the following important existing conditions of the riparian area: stand type, site potential tree height, and stream shading.

The predominant riparian stand type along South Fork Lost Creek within the project area is western red cedar/oak fern. Although western red cedar is typically the dominant species during late seral and climax stages, other species such as grand fir, Engelmann spruce, Douglas-fir, and western larch are also major components of the overstory (*Hansen et al 1995*). Furthermore, the riparian stand

type as it relates to the associated geology and soils can be classified as exhibiting both SL2B and SL3B characteristics, which primarily occur adjacent to B and C channel types with stream gradients ranging from 1 to 12 percent (*Sirucek and Bachurski 1995*). Where the SL2B and SL3B riparian landtypes occur with the stand type described above, expected conditions are somewhat poorly drained sites with deep, weakly developed, gravely or bouldery, sandy loams or loams (*Sirucek and Bachurski 1995*).

Five riparian forest surveys in Section 3, T24N, R17W, assessed specific riparian stand conditions adjacent to South Fork Lost Creek. During the surveys, all trees (live and dead) with a dbh (4.5 feet above the ground) were recorded. Results of the surveys indicate that the quadratic mean diameter of riparian trees is 9.1 inches, the average number of trees per acre is 764, and the average basal area per acre is 346.0 square feet.

Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site potential tree height of dominant and co-dominant trees at 100 years (*ARM 36.11.425[5]*) is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest units in Section 3, T24N, R17W. The site potential tree height along riparian zones adjacent to the proposed harvest units is approximately 95 feet, and calculations of the measure are displayed in *TABLE E-9 – CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUTH FORK LOST CREEK*.

Riparian areas also provide stream shading, which contributes to the regulation of stream temperature regimes by intercepting direct solar radiation to the stream channel. During winter seasons, riparian areas may also function to

TABLE E-9 – CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUTH FORK LOST CREEK*

SAMPLE	SPECIES	HEIGHT (FEET)	AGE (YEARS)	SITE INDEX (BEST FIT)	SITE POTENTIAL TREE HEIGHT @ 100 YEARS (FEET)	MEAN SITE POTENTIAL TREE HEIGHT @ 100 YEARS (FEET)	REFERENCE
1	Grand fir	70	55	45	116		USFS RN-71
2	Grand fir	92	102	30	91		USFS RN-71
3	Grand fir	43	90	30	91		USFS RN-71
4	Grand fir	53	135	30	91		USFS RN-71
5	Grand fir	56	95	30	91		USFS RN-71
6	Western red cedar	87	95	N/A**	92**		N/A**
						95	

**Samples were taken by DNRC personnel during July 2004 from random dominant and co-dominant trees with average growth at a distance of 50 feet from the bankfull slope break.*

***Western red cedar height relative to age is generally inconsistent, which does not lend well to reliable index curves for the species. The site potential tree height at 100 years for this sample was estimated.*

regulate stream temperatures by inhibiting temperature loss through evaporation, convection, or long-wave radiation from the stream (*Beschta et al 1987*). The degree to which a riparian area blocks direct solar radiation to the stream can be determined by measuring the angular canopy density, which is a function of riparian tree species composition, stand age, and tree density (*Beschta et al 1987*). Samples of angular canopy density were taken at 6 locations from the center of South Fork Lost Creek during 2004, and measurements were taken for the months of July and August (the months during which direct solar radiation has the greatest potential effect on stream-temperature regimes). Results of these measurements indicate that the existing riparian tree vegetation blocks an average of 65 percent of direct solar radiation during July and an average of 81 percent during August.

A past disturbance to the riparian area includes the construction and location of USFS Road 680, which lies north of South Fork Lost Creek through the project area. The majority of the road corridor lies outside of the area encompassed by the site potential tree height, but approximately 1,300 linear feet of the road corridor lies within 10 to 95 feet of the bankfull slope break of South Fork Lost Creek. Based on field estimates, the average distance between the road corridor and the bankfull slope break within the 1,300 linear foot zone is approximately 70 feet. As the road lies to the north of the stream, stream shading has likely been little affected; however, the road corridor is likely having a low existing impact through reduced recruitable large woody debris.

Other past disturbance in the riparian area includes the harvest of isolated western larch. Based on field observations, this past harvest of western larch occurred at least 30 years ago at a rate of approximately one tree per 200 linear feet.

Due to the location of the USFS Road 680 corridor, low direct and indirect impacts to the riparian function component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation; this material is a critical component in the formation of complex habitat for bull trout and westslope cutthroat trout. All life stages of bull trout and westslope cutthroat trout have been observed closely associating with large woody debris in the Flathead River basin (*Pratt 1984, Shepard et al 1984*). Large-woody-debris recruitment rates to South Fork Lost Creek throughout the project area can be described using large-woody-debris counts per stream length, and this data was collected during 2002 as part a *R1/R4 Fish Habitat Standard Inventory (Overton et al 1997)* (see *TABLE E-10 – LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUTH FORK LOST CREEK [KOOPAL 2002])*. Large-woody-debris counts for South Fork Lost Creek include all stream habitats from the confluence with North Fork Lost Creek (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 4.94).

TABLE E-10 – LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUTH FORK LOST CREEK

	REACH			
	1	2	3	4
Channel type	C	B	C	B
Total reach length (feet)	9,264	8,763	4,238	3,778
Total number of single pieces	99	106	48	36
Total number of pieces in aggregates	458	696	289	334
Total number of root wads	20	23	10	14
Total pieces of large woody debris in reach	577	825	347	384
Number of pieces per 1,000 feet	62	94	82	102

Data from reference reaches (*Harrelson et al 1994*) throughout the Flathead River basin region indicate that the expected frequency of large woody debris in undisturbed B channels ranges from 74 to 172 pieces per 1,000 feet (*Bower 2006*). This data suggests that the existing frequencies of large woody debris in Reaches 2 and 4 of South Fork Lost Creek are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics. Likewise, data indicates that the expected frequency of large woody debris in undisturbed C channels in the region ranges from 1 to 121 pieces per 1,000 feet (*Bower 2006*). This data suggests that the existing frequencies of large woody debris in Reaches 1 and 3 of South Fork Lost Creek are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics.

No apparent direct and indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Stream Temperature**

Stream temperature data for South Fork Lost Creek is available for 2001, 2003, 2004, and 2005 and is displayed in

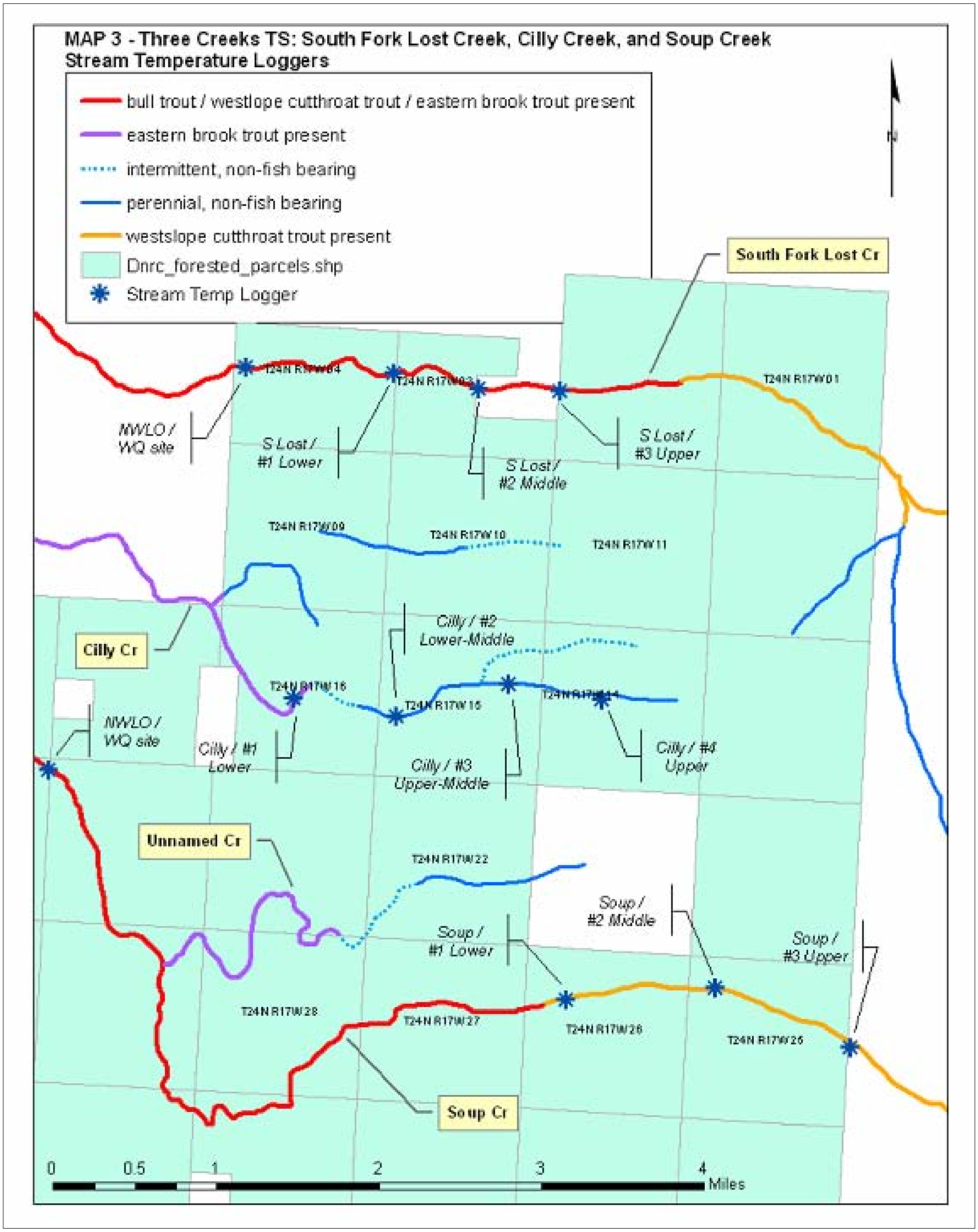
*TABLE E-11 – STREAM TEMPERATURE DATA FOR SOUTH FORK LOST CREEK**

SITE NAME	MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS)	WARMEST DAY OF MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS)		DAYS GREATER THAN		
		DATE	MAXIMUM	10.0	15.0	21.1
				CELSIUS		
SFKLost_NWLO_WQsite_2001	11.7	08/15/01	11.8	58	0	0
SFKLost_NWLO_WQsite_2003	12.7	07/23/03	12.9	69	0	0
SFKLost_NWLO_WQsite_2004	12.1	07/16/04	12.6	52	0	0
SFKLost#1_Lower_2004	11.4	07/15/04	11.9	44	0	0
SFKLost#2_Middle_2004	11.2	07/16/04	11.7	40	0	0
SFKLost#3_Upper_2004	11.7	07/16/04	12.2	45	0	0
SFKLost_NWLO_WQsite_2005	11.5	08/09/05	11.7	45	0	0
SFKLost#1_Lower_2005	10.7	07/19/05	10.9	33	0	0
SFKLost#2_Middle_2005	10.5	07/19/05	10.7	31	0	0
SFKLost#3_Upper_2005	11.3	08/06/05	11.4	38	0	0

**Samples obtained by DNRC resource specialists using Water Temp Pro (Onset Corporation) data loggers.*

TABLE E-11 – STREAM TEMPERATURE DATA FOR SOUTH FORK LOST CREEK. FIGURE E-3 – THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM TEMPERATURE LOGGERS displays the locations of stream-temperature data recorders on South Fork Lost Creek.

FIGURE E-3 – THREE CREEKS TIMBER SALE PROJECT: SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM-TEMPERATURE LOGGERS



Stream temperature data indicates that the annual maximum weekly maximum temperature at the water-quality sample site has ranged from 11.5 to 12.7 degrees Celsius for the years 2001, 2003, 2004, and 2005. During these years the maximum seasonal temperature recorded at the water-quality sample site ranged from 11.7 to 12.9 degrees Celsius. For comparison, a maximum seasonal temperature of 12.2 degrees Celsius was recorded during 1983 approximately 1,000 feet downstream of the water-quality sample site (*Leathe et al 1985*), which suggests that maximum seasonal temperatures in the vicinity of this location of South Fork Lost Creek may not have been markedly variable during the past 2 decades.

Rates of change in stream temperature are typically variable between different stream segments, as rates of change in stream temperature are generally a function of variations in stream shading, aspect, stream volume, net radiation, evaporation, convection, conduction, groundwater interactions, and inputs from tributaries (*Beschta et al 1987*). During 2004, the rate of change in maximum weekly maximum stream temperature between SFKLost#3 and SFKLost#2 is approximately –0.5 degrees Celsius per half mile, +0.2 degrees Celsius per half mile between SFKLost#2 and SFKLost#1, and +0.4 degrees Celsius per half mile between SFKLost#1 and SFKLost_NWLO_WQsite. During 2005, the rate of change in maximum weekly maximum stream temperature between SFKLost#3 and SFKLost#2 is approximately minus 0.8 degrees Celsius per half mile, +0.2 degrees Celsius per half mile between SFKLost#2 and SFKLost#1, and +0.4 degrees Celsius per half mile between SFKLost#1 and SFKLost_NWLO_WQsite. It is highly likely that inputs from cooler groundwater influenced the stream temperature regime between SFKLost#3 and SFKLost#2, where the maximum weekly maximum stream temperature dropped appreciably at the rate of approximately –0.5 degrees Celsius per half mile during 2004 and at the rate of approximately –0.8 degrees Celsius per half mile during 2005. Groundwater interactions are known to affect many of the streams in the Swan River valley (*Baxter 1997, Stanford and Ward 1993*), and the stream temperature effects of groundwater interactions likely occur periodically in other reaches of South Fork Lost Creek. However, the extent to which different groundwater interactions affect stream temperatures is generally a function of a multitude of site-specific variables and not consistent across drainages.

In respect to bull trout, the temperature ranges described in *TABLE E-11 – STREAM-TEMPERATURE DATA FOR SOUTH FORK LOST CREEK* are within the species' tolerances as observed in various studies. *Fraley and Shepard (1989)* rarely observed juvenile bull trout in streams exceeding 15 degrees Celsius. *Gamett (2002)* did not find bull trout where maximum stream temperatures exceeded 20 degrees Celsius. *Reiman and Chandler (1999)* found that bull trout are most frequently observed in streams having summer maximum temperatures of approximately 13 to 14 degrees Celsius.

No apparent direct and indirect impacts to the stream temperature component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Connectivity**

The project area has 2 bridge crossings over South Fork Lost Creek in the NW1/4SW1/4 of Section 4, and the NW1/4SE1/4 of Section 2, all in T24N, R17W. These crossings provide full passage of all life stages of bull trout and westslope cutthroat trout.

A set of naturally occurring waterfalls in the NW1/4SE1/4 of Section 2, T24N, R17W (river mile 4.94) pose complete migration barriers to bull trout and westslope cutthroat trout. Both bull trout and westslope cutthroat trout exist below the barriers, and only westslope cutthroat trout are known to exist upstream of the barriers.

Although the waterfall migration barriers limit bull trout and westslope cutthroat trout migration in South Fork Lost Creek, the stream features are naturally occurring and not considered an existing impact. No direct and indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek – Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the South Fork Lost Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE E-12 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUTH FORK LOST CREEK*.

One related action includes past and present construction on the road system in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The road system has been assessed for specific sources of sedimentation to streams in the South Fork Lost

TABLE E-12 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUTH FORK LOST CREEK

	EXISTING IMPACTS TO BULL TROUT AND WESTSLOPE CUTTHROAT TROUT IN SOUTH FORK LOST CREEK
Populations – presence and genetics	Low to high
Habitat – flow regimes	Very low
Habitat – sediment	None
Habitat – channel forms	None
Habitat – riparian function	Low
Habitat – large woody debris	None
Habitat – stream temperature	None
Habitat – connectivity	None
Other related actions	Very Low to moderate
Existing collective impacts	*Moderate*

Creek watershed. Estimates indicate that approximately 19.8 tons per year of road material are contributed to streams in the South Fork Lost Creek watershed by the existing road system (see *WATERSHED AND HYDROLOGY ANALYSIS*). The collective effect from the existing road system, as represented by the estimated amount of material contributed to streams, likely represents an existing low to moderate impact to bull trout and westslope cutthroat trout in South Fork Lost Creek.

Other related actions that are considered in the existing collective impacts are a very low impact due to fishing and other related recreational uses, a low impact from past forest-management activities on upstream land ownerships, and a low impact from road and road-stream crossing construction and maintenance activities on upstream land ownerships.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, existing collective impacts to bull trout and westslope cutthroat trout in South Fork Lost Creek is likely moderate.

- ***CILLY CREEK***

Cilly Creek is a second-order stream and only a very short reach within the project area is considered fish bearing.

- **Cilly Creek Populations – Presence and Genetics**

Eastern brook trout are the only fish inhabiting Cilly Creek within and adjacent to the project area. Although bull trout and westslope cutthroat trout likely inhabited Cilly Creek to some degree prior to an eastern brook trout invasion, several different surveys confirm that the native species no longer utilize the stream as habitat. A redd count survey during 1982 revealed no bull trout spawning in Cilly Creek (*Leathe et al 1985*). Another redd count survey during 1996 revealed no westslope cutthroat trout spawning in Cilly Creek (*T. Weaver, FWP Kalispell*). Electrofishing surveys of species presence during 1983 (*Leathe et al 1985*), 2004 (*T. Weaver, DFWP Kalispell*), and 2005 (*J. Bower, DNRC Missoula*) also confirmed that native species do not utilize Cilly Creek as habitat.

As eastern brook trout currently thrive in Cilly Creek, a presumption that bull trout and westslope cutthroat trout historically occupied the stream to some unknown degree is reasonable. The complete displacement by eastern brook trout, therefore, constitutes a moderate to high existing impact to bull trout and westslope cutthroat trout populations and genetics in Cilly Creek.

- **Cilly Creek Habitat – Flow Regimes**

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*.) The analysis of hydrologic data for Cilly Creek indicates that the existing average departure in flow regime is approximately 2.3 percent above the range of naturally occurring conditions (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

  Changes in flow regime can affect fisheries through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish-habitat variables. As a consequence, a very low likelihood for very low direct and indirect impacts to these habitat characteristics exists as a result of the estimated 2.3-percent increase in flow regime to Cilly Creek within the project area.

  Changes in flow regime have been known to affect fish spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, a very low likelihood for very low direct and indirect impacts to native and nonnative fish species exists as a result of flow regime modifications to Cilly Creek within the project area.

- **Cilly Creek Habitat – Sediment**

  The stream morphology of the fish-bearing reach of Cilly Creek within the project area is described using the *Rosgen* river classification (*Rosgen 1996*). The fish-bearing reach of the stream exhibits a 'B4' channel type. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B4 morphological type is characteristic of channel compositions dominated by gravels (*Rosgen 1996*). As this condition appears consistent with those found in *Leathe et al (1985)*, the existing sediment characteristics of Cilly Creek are likely representative of historic trends. Furthermore, field surveys of the stream during 2004 and 2005 did not reveal channel or riparian disturbances that would otherwise point toward a deviation in the expected characteristics of sediment. No direct and indirect impacts to the sediment component of fish habitat likely exist in Cilly Creek.

  (In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the Cilly Creek

drainage are considered an unspecified, collective effect. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of *EXISTING CONDITIONS* of this analysis.)

- **Cilly Creek Habitat – Channel Forms**

The description of channel formation used to describe existing fish habitat in Cilly Creek is the *Montgomery/ Buffington* classification (*Montgomery and Buffington 1997*). The stream gradient of the fish-bearing reach of Cilly Creek primarily ranges from 1 to 3 percent. The stream formations of the reach are broadly described as exhibiting the 'forced pool-riffle' and 'pool-riffle' *Montgomery/ Buffington* classification. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream. Both 'pool-riffle' channel forms typically exhibit pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). No direct or indirect impacts to the channel form component of fish habitat are apparent in Cilly Creek.

- **Cilly Creek Habitat – Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream nutrient inputs, and other variables (*Hansen et al 1995*). This section will consider the following important existing conditions of the riparian area: site potential tree height and stream shading.

Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site potential tree height of dominant and co-dominant trees at 100 years (*ARM 36.11.425[5*]) is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest units in Section 16, T24N, R17W. The site potential tree height calculated by DNRC personnel during 2004 is 91 feet. The measure was calculated from 2 samples of grand fir adjacent to the fish-bearing reach.

Riparian areas also provide stream shading, which contributes to the regulation of stream temperature regimes by intercepting direct solar radiation to the stream channel. During winter seasons, riparian areas may also function to regulate stream temperatures by inhibiting temperature loss through evaporation, convection, or long-wave radiation from the stream (*Beschta et al 1987*). The degree to which a riparian area blocks direct solar radiation to the stream can be determined by measuring the angular canopy density, which is a function of riparian tree species composition, stand age, and tree density (*Beschta et al 1987*). Samples of angular canopy density were taken at 6 different locations from the center of the fish-bearing reach of Cilly Creek during 2004, and measurements were taken for the months of July and August (the months during which direct solar radiation has the greatest

potential effect on stream temperature regimes). Results of these measurements indicate that the existing riparian tree vegetation blocks an average of 76 percent of direct solar radiation during July and an average of 83 percent during August.

Past disturbance in the riparian areas of Cilly Creek include the random, selective harvesting of large trees until approximately 30 years ago. The potential existing impacts are low since the result of the past associated action poses an existing low risk of reduced recruitable large woody debris over the foreseeable near future.

- **Cilly Creek Habitat – Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is an important component in the formation of habitat for fish. The frequency of existing large woody debris in the fish-bearing reach of Cilly Creek is likely consistent with the range of frequencies observed in other B channels on nearby South Fork Lost Creek and Soup Creek and described within this analysis. No direct and indirect impacts to the large-woody-debris component of fish habitat likely exist in Cilly Creek.

- **Cilly Creek Habitat – Stream Temperature**

Stream temperature data for Cilly Creek is available for 2004 and 2005 and is displayed in *TABLE E-13 – STREAM TEMPERATURE DATA FOR CILLY CREEK*. *FIGURE E-3 – THREE CREEKS TIMBER SALE PROJECT: SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM TEMPERATURE LOGGERS* displays the locations of stream temperature data recorders on Cilly Creek.

Rates of change in stream temperature are typically variable between different stream segments, as rates of change in stream temperature are generally a function of variations in stream shading, aspect, stream volume, net radiation, evaporation, convection, conduction, groundwater interactions, and inputs from tributaries (*Beschta et al 1987*). During 2004, the rate of change in maximum weekly maximum stream temperature between Cilly#4 and Cilly#3 is approximately +1.1 degrees Celsius per half mile, +1.0 degrees Celsius per half mile between Cilly#3 and Cilly#2, and –3.2 degrees Celsius per half

TABLE E-13 – STREAM-TEMPERATURE DATA FOR CILLY CREEK*

SITE NAME	MAXIMUM WEEKLY MEAN TEMPERATURE (CELSIUS)	WARMEST DAY OF MAXIMUM WEEKLY MEAN TEMPERATURE (CELSIUS)		DAYS GREATER THAN		
				10.0	15.0	21.1
		DATE	MAXIMUM	CELSIUS		
Cilly#1_Lower_2004	7.5	08/13/04	7.6	0	0	0
Cilly#2_Lower-Middle_2004	12.1	08/17/04	12.5	50	0	0
Cilly#3_Upper-Middle_2004	10.6	08/17/04	10.8	34	0	0
Cilly#4_Upper_2004	9.3	08/16/04	9.7	0	0	0
Cilly#1_Lower_2005	7.9	06/21/05	8.7	0	0	0
Cilly#2_Lower-Middle_2005	10.9	08/07/05	11.0	29	0	0
Cilly#3_Upper-Middle_2005	10.4	08/09/05	10.5	13	0	0
Cilly#4_Upper_2005	8.8	08/09/05	8.9	0	0	0

**Samples obtained by DNRC resource specialists using Water Temp Pro (Onset Corporation) data loggers.*

mile between Cilly#2 and Cilly#1. During 2005, the rate of change in maximum weekly maximum stream temperature between Cilly#4 and Cilly#3 is approximately +1.4 degrees Celsius per half mile, +0.3 degrees Celsius per half mile between Cilly#3 and Cilly#2, and –2.1 degrees Celsius per half mile between Cilly#2 and Cilly#1. It must be noted that between Cilly#2 and Cilly#1 field surveys have observed the stream losing all surface flows to subsurface flows during the period of seasonal maximum stream temperatures. It is, therefore, readily apparent that inputs from cooler groundwater influenced the stream temperature regime between Cilly#2 and Cilly#1, where the maximum weekly maximum stream temperature dropped appreciably at the rate of approximately minus 3.2 degrees Celsius per half mile during 2004 and at the rate of approximately –2.1 degrees Celsius per half mile during 2005. Groundwater interactions are known to affect many of the streams in the Swan River valley (*Baxter 1997, Stanford and Ward 1993*), and the stream temperature effects of groundwater interactions likely occur periodically in other reaches of Cilly Creek. However, the extent to which different groundwater interactions affect stream temperatures is generally a function of a multitude of site-specific variables and not consistent across drainages.

No direct and indirect impacts to the stream temperature component of fish habitat are apparent in Cilly Creek.

- **Cilly Creek Habitat – Connectivity**

Cilly Creek has 1 bridge crossing in the project area located in the NW1/4SE1/4 of Section 7, T24N, R17W. The bridge crossing provides full passage of all life stages of eastern brook trout (and bull trout and westslope cutthroat trout, if those species were present). Also, 3 culvert crossings of Cilly Creek are in the project area in the NW1/4SW1/4 of Section 8, the NW1/4NW1/4 and the NE1/4SW1/4 of Section 16, all in T24N, R17W. These 3 crossings provide full passage of most adult eastern brook trout (and most adult bull trout and westslope cutthroat trout, if those species were present). These crossings represent low direct and indirect impacts to the connectivity component of fish habitat existing in Cilly Creek.

- **Cilly Creek – Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the Cilly Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE E-14 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN CILLY* CREEK.

One related action includes past and present construction on the road system in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening,

TABLE E-14 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN CILLY CREEK

	EXISTING IMPACTS TO NATIVE AND NONNATIVE FISH IN SOUP CREEK
Populations – presence and genetics	Moderate to high
Habitat – flow regimes	Very Low
Habitat – sediment	None
Habitat – channel forms	None
Habitat – riparian function	Low
Habitat – large woody debris	None
Habitat – stream temperature	None
Habitat – connectivity	Low
Other related actions	Very low to low
Existing collective impacts	*Moderate*

and modifications to temperature regimes. The existing road system has been assessed for specific sources of sedimentation to streams in the Cilly Creek watershed. Estimates indicate that approximately 2.9 tons per year of road material are contributed to streams in the Cilly Creek watershed by the existing road system (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*). The collective effect from the existing road system, as represented by the estimated amount of material contributed to streams, likely represents an existing low impact to fish in Cilly Creek.

Other related actions that are considered in the existing collective impacts are a very low impact due to fishing and other related recreational uses, a low impact from past forest-management activities on other land ownerships, and a low impact from road and road-stream crossing construction and maintenance activities on other land ownerships.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, a moderate collective impact to bull trout and westslope cutthroat trout likely exists in Cilly Creek.

- ***UNNAMED CREEK***

Unnamed Creek is a second-order stream, and the fish-bearing reach of the stream is downstream of the project area.

- **Unnamed Creek Populations – Presence And Genetics**

Based on a thorough electrofishing survey of Unnamed Creek during 2005 (*J. Bower, DNRC Missoula*), eastern brook trout were determined to be the only fish inhabiting Unnamed Creek downstream from the project area. Measurements of relatively high stream temperatures (see *UNAMED CREEK HABITAT – STREAM TEMPERATURE*)

likely indicate that the stream is a thermal barrier to bull trout and westslope cutthroat trout. Neither native species has likely ever utilized Unnamed Creek as habitat for any period of time. No direct and indirect impacts to bull trout and westslope cutthroat trout presence and genetics exist in Unnamed Creek.

- **Unnamed Creek Habitat – Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*.) The analysis of hydrologic data for Unnamed Creek indicates that the existing average departure in flow regime is approximately 0.5 percent above the range of naturally occurring conditions, which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

Changes in flow regime can affect fisheries through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish habitat variables.

Consequently, the likelihood is very low for very low direct and indirect impacts to these habitat characteristics as a result of the estimated 0.5-percent increase in flow regime to Unnamed Creek downstream of the project area.

Major sections of the fish-bearing reach of Unnamed Creek seasonally dewater and exhibit intermittent flows.

Changes in flow regime have been known to affect fish spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, the likelihood is very low for very low direct and indirect impacts to nonnative fish species as a result of flow regime modifications to Unnamed Creek downstream of the project area.

- **Unnamed Creek Habitat – Sediment**

The stream morphology of the fish-bearing reach of Unnamed Creek downstream of the project area is described using the *Rosgen* river classification (*Rosgen 1996*). The fish-bearing reach of the stream alternates between 'B4', 'C4', and 'E5' channel types. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). The C morphological type broadly includes meandering streams with both riffles and pools in low-gradient, broad, alluvial valley bottoms (*Rosgen 1996*). The E morphological type broadly includes riffle-pool-dominated, low-gradient streams in broad alluvial valleys with well-developed floodplains (*Rosgen 1996*). Furthermore, the B4 and C4 morphological type is

characteristic of channel compositions dominated by gravels, while the E5 morphological type is characteristic of channel compositions dominated by sands (*Rosgen 1996*). Several large beaver dam complexes exist within the 'E5' and 'C4' channel types. Field surveys of the stream during 2005 did not reveal channel or riparian disturbances that would otherwise point toward a deviation in the expected characteristics of sediment. No direct and indirect impacts to the sediment component of fish habitat likely exist in Unnamed Creek.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the Unnamed Creek drainage are considered an unspecified, collective effect. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of *EXISTING CONDITIONS* of this analysis.)

- **Unnamed Creek Habitat – Channel Forms**

The description of channel formation used to describe existing fish habitat in Unnamed Creek is the *Montgomery/ Buffington* classification (*Montgomery and Buffington 1997*). The stream gradient of the fish-bearing reach of Unnamed Creek primarily ranges from 1 to 4 percent. In those reaches of the stream that flow through forested areas, the stream formations are broadly described as exhibiting the 'forced pool-riffle' and 'pool-riffle' *Montgomery/Buffington* classification. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream. Both 'pool-riffle' channel forms typically exhibit pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). In those reaches of the stream that flow through various sedge meadow complexes, the stream formations are broadly described as exhibiting the 'plane bed' *Montgomery/ Buffington* classification. The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*). Several large beaver dam complexes exist within the fish-bearing reach of Unnamed Creek. No direct and indirect impacts to the channel form component of fish habitat are apparent in Unnamed Creek.

- **Unnamed Creek Habitat – Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream-nutrient inputs, and other variables (*Hansen et al 1995*). The proposed forest-management activities associated with each alternative are not expected to occur adjacent to the fish-bearing reach of Unnamed Creek. For this reason, a description of the existing condition of site potential tree height is not needed for the fisheries analysis.

Riparian areas also provide stream shading, which contributes to the regulation of stream temperature regimes by intercepting direct solar radiation to the stream channel. Field surveys of the stream

during 2005 did not reveal extraordinary riparian disturbances that would otherwise point toward a deviation in the expected range of stream-shade conditions.

However, past disturbance in the riparian areas of Unnamed Creek may include the random, selective harvesting of large trees up to approximately 30 years ago. This random, selective riparian harvesting likely represents a potential low-existing impact to nonnative fisheries in Unnamed Creek. A potential low impact exists since the result of the past associated action poses an existing low risk of reduced recruitable large woody debris over the foreseeable near future.

- **Unnamed Creek Habitat – Large Woody Debris**

  Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is an important component in the formation of habitat for fish. The frequency of existing large woody debris in the fish-bearing reach of Unnamed Creek is likely consistent with the range of frequencies observed in other B and C channels on nearby South Fork Lost Creek and Soup Creek and is described within this analysis. In those reaches of the stream that flow through various sedge meadow complexes, field surveys did not reveal large woody debris as playing an important role in stream function. No direct and indirect impacts to the large-woody-debris component of fish habitat likely exist in Unnamed Creek.

- **Unnamed Creek Habitat – Stream Temperature**

  Instantaneous daytime stream temperatures were recorded at 3 different locations of the fish-bearing reach of Unnamed Creek on June 23, 2005. The 3 measures were 15.5, 17.0, and 21.5 degrees Celsius. These daytime stream temperatures are relatively high for the month of June compared to other fish-bearing streams in the project area, and the stream temperatures during July and August are expected to be even greater. The simple measures from June 23, 2005 are likely indicative of a stream that presents a thermal barrier to bull trout and westslope cutthroat trout. Although these temperatures are relatively high, the field surveys of the stream during 2005 did not reveal extraordinary riparian disturbances or stream conditions that would otherwise point toward a deviation in the observed range of stream temperature. No apparent direct or indirect impacts to the stream temperature component of fish habitat exist in Unnamed Creek.

- **Unnamed Creek Habitat – Connectivity**

  Two culvert crossings of Unnamed Creek exist in the project area in the NE1/4NE1/4 of Section 29, T24N, R17W and the SW1/4NW1/4 of Section 28, T24N, R17W. The culvert crossing in Section 29 poses a migration barrier to eastern brook trout except for a portion of the strongest swimming adults. The culvert crossing in Section 28 poses a complete migration barrier to all life stages of eastern brook trout. The 2 culvert crossings represent an existing moderate to high direct and indirect impact to the connectivity

component of fish habitat in Unnamed Creek.

- **Unnamed Creek – Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the Unnamed Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE E-15 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN UNNAMED CREEK*.

One related action includes past and present construction on the existing road system in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The existing road system has not been assessed for specific sources of sedimentation to streams in the Unnamed Creek watershed. However, the impacts in the Unnamed Creek watershed are likely similar to those found in Cilly Creek since both watersheds are comparable in size, historic-management regimes, and past road development. The collective effect from the existing road system then likely represents an existing low impact to fish in Unnamed Creek.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, a moderate collective impact to fisheries likely exists in Unnamed Creek.

TABLE E-15 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN UNNAMED CREEK

	EXISTING IMPACTS TO NONNATIVE FISH IN UNNAMED CREEK
Populations – presence and genetics	None
Habitat – flow regimes	Very Low
Habitat – sediment	None
Habitat – channel forms	None
Habitat – riparian function	Low
Habitat – large woody debris	None
Habitat – stream temperature	None
Habitat – connectivity	Moderate to high
Other related actions	Very low to low
Existing collective impacts	*Moderate*

- ***SOUP CREEK***

Soup Creek is a third-order stream and the entire reach within the project area is considered fish-bearing.

- **Soup Creek Populations – Presence and Genetics**

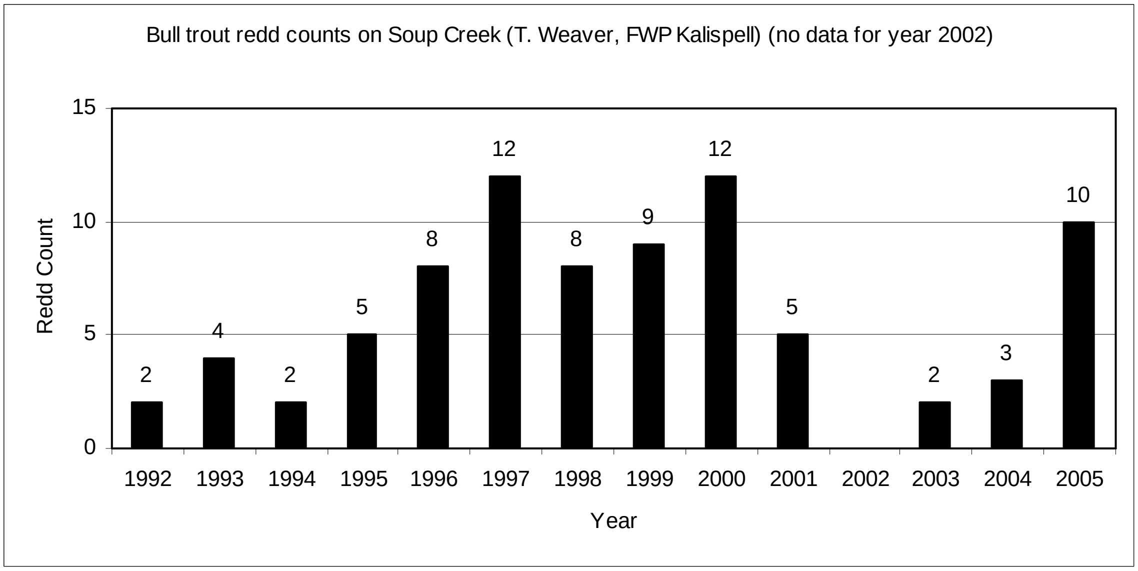
The Soup Creek watershed has been identified as a core habitat area within the Swan River drainage bull trout conservation area (*MBTSG 1996, MBTRT 2000*). Core areas are watersheds, including tributary drainages and adjoining uplands, used by migratory bull trout for spawning and early rearing, and by resident bull trout for all life history requirements (*MBTRT 2000*). Although bull trout may exhibit the resident life form in Soup Creek, this stream is used by bull trout primarily as spawning and rearing habitat for adfluvial populations associated with Swan Lake. Soup Creek supports westslope cutthroat trout exhibiting adfluvial, fluvial, and resident life forms.

Genetic data suggests that migratory bull trout adults in the upper Flathead River system have been found to frequently return to their natal or near-natal streams (*Kanda et al 1997*), and populations of migratory spawning bull trout in the Flathead River system have been observed returning to the same stream reaches during subsequent spawning runs (*Fraley and Shepard 1989*). This propensity for habitual adult migration to natal or near-natal streams and the consequent selection of unique spawning locations would make the use of redd counts in Soup Creek a useful measure of overall bull trout success in occupying this specific subbasin. Similarly, westslope cutthroat trout redd counts would be expected to express that species' overall success in occupying spawning and rearing habitats provided by Soup Creek.

The protocol for collecting redd-count data in South Fork Lost Creek is described in *Weaver and Fraley (1991)*. Experienced crews and fixed-survey reaches are used for result consistency.

The data in *TABLE E-16 – BULL TROUT REDD COUNTS IN SOUP CREEK, 1992 THROUGH 2005* shows that number of bull trout redds constructed in the Soup Creek reference reach has ranged from 2 to 12 during the years 1992 to 2004. This table contains insufficient data to describe a trend in bull trout redd counts with a high degree of certainty. An analysis of bull trout redd counts from throughout the Swan drainage suggests that the larger bull trout population may be increasing (*Rieman and Myers 1997*), but the same study also indicates that a larger data set than that provided in *TABLE E-16 – BULL TROUT REDD COUNTS IN SOUP CREEK, 1992 THROUGH 2005* is likely needed in order to begin identifying long-term trends of bull trout populations in individual streams. However, *Weaver (2005)* has indicated that the existing Swan River drainage bull trout population appears to be stable, and redd counts from South Fork Lost Creek and Soup Creek are generally representative of trends in other bull trout spawning streams within the drainage. *Weaver (2005)* noted that increases in bull trout redd counts from 1996 through 2000 may have been due to a strong bull trout population response to *Mysis* shrimp densities in Swan Lake. (*Mysis* is an introduced macroinvertebrate to Swan Lake that has contributed to the food base of adfluvial

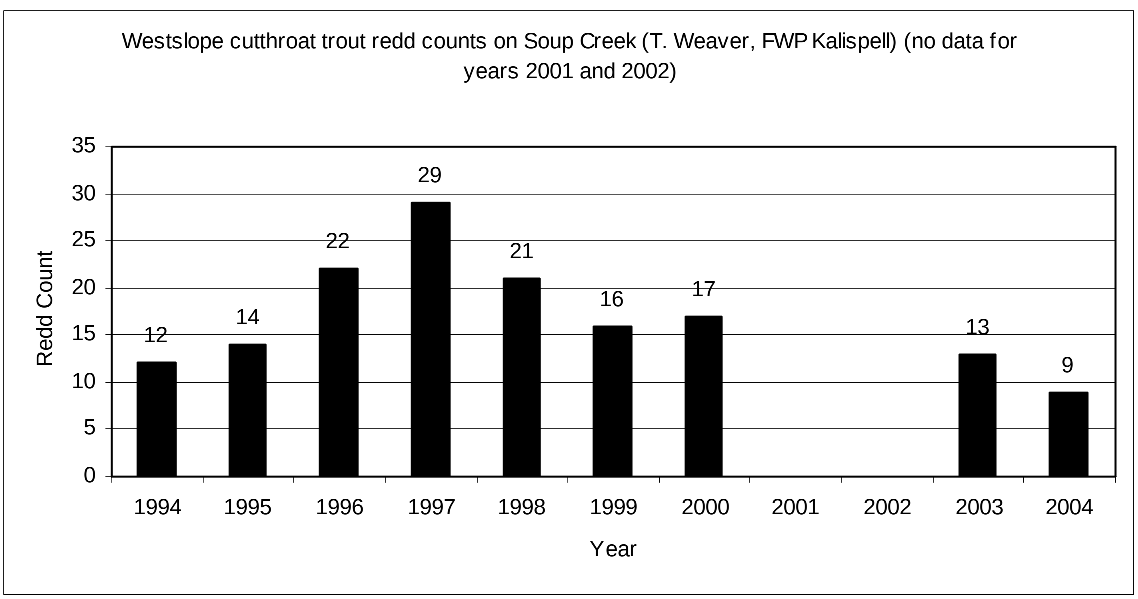
TABLE E-16 – BULL TROUT REDD COUNTS IN SOUP CREEK, 1992 THROUGH 2005



bull trout and westslope cutthroat trout.) The data in *TABLE E-17 – WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUP CREEK, 1994 THROUGH 2004* shows the number of westslope cutthroat trout redds constructed in the Soup Creek reference reach has ranged from 9 to 29 during the years 1994 through 2004. Although this table also has insufficient data to describe a trend in westslope cutthroat trout redd counts with a high degree of certainty, this data is likely indicative of a generally stable westslope cutthroat trout population associated with the Soup Creek drainage.

Leathe et al (1985) describes bull trout and westslope cutthroat trout population

TABLE E-17 – WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUP CREEK, 1994 THROUGH 2004



densities in 3 reaches of Soup Creek as ranging from low to high (see *TABLE E-18 – SPECIES DENSITIES IN SOUP CREEK, 1982 THROUGH 1983 [LEATHE ET AL 1985]*). Reach 1 starts at the confluence of Swan River and Soup Creek and extends upstream to river mile 6.34. Reach 2 includes that portion of Soup Creek from river mile 6.34 to 7.64, and Reach 3 extends from river mile 7.64 to 9.32.

Independent of the current population status, there are considerable existing and future risks to both bull trout and westslope cutthroat trout populations and genetics in Soup Creek and throughout the Swan River drainage. Perhaps the greatest future threats to bull trout in the Swan River drainage are from the introduction and spread of nonnative fish (*MBTSG 1996*). The recently confirmed introduction and reproduction of lake trout (*Salvelinus namaycush*) in Swan Lake is expected to have some level of acute negative effect to bull trout within the Swan River drainage. Lake trout will likely have a negative affect on bull trout populations in Swan Lake through the predation of juvenile and subadult life stages and niche displacement. These foreseeable interactions will likely be expressed through lower rates of bull trout redd count construction in Soup Creek.

Bull trout are also negatively affected by nonnative eastern brook trout primarily through hybridization and, to some extent, by the displacement of juvenile fish in rearing habitats. Data suggests that bull trout and eastern brook trout hybridization has occurred throughout the Swan River drainage (*Kanda et al 1997*). Although several factors point toward hybridization as a lower overall risk to bull trout than that of displacement by lake trout: migratory bull trout tend to have a reproductive size advantage over resident eastern brook trout (*Rieman and McIntyre 1993*) and offspring can have a considerable chance of being sterile or exhibiting other progressive growth problems (*Leary et al 1983*).

Westslope cutthroat trout also face considerable threats from the introduction and spread of nonnative fish. Introgression from hybridization with rainbow trout (*Oncorhynchus mykiss*) and other cutthroat trout subspecies may pose the foremost risk to westslope cutthroat trout in Montana (*Liknes and Graham 1988*). Westslope cutthroat trout within Soup Creek below migration-barrier cascades at approximate river mile 7.50 are

TABLE E-18 – SPECIES DENSITIES IN SOUP CREEK, 1982 THROUGH 1983 (LEATHE ET AL 1985)

	NUMBER OF FISH GREATER THAN 75 MILLIMETERS PER 300 METERS			**NUMBER OF FISH GREATER THAN 150 MILLIMETERS PER 300 METERS**		
REACH/YEAR SURVEYED	**BULL TROUT**	**WESTSLOPE CUTTHROAT TROUT**	**EASTERN BROOK TROUT**	**BULL TROUT**	**WESTSLOPE CUTTHROAT TROUT**	**EASTERN BROOK TROUT**
1/1983	3 ('low')	0	279 ('high')	0	0	48 ('mod')
2/1982	0	240 ('high')	0	0	46 ('moderate')	0
3/1983	0	0	0	0	0	0

expected to express some level of introgression (*NRIS 2004*). Westslope cutthroat trout upstream of the migration barrier falls were determined to be 100 percent genetically pure from samples taken in 1983 (*MFISH 2005*). Westslope cutthroat trout are quite susceptible to displacement by introduced salmonids, especially eastern brook trout; however, the variable mechanisms through which this occurs are not well understood (*Griffith 1988*). Eastern brook trout are not known to exist upstream of the migration-barrier falls.

Existing impacts to bull trout and westslope cutthroat trout populations and genetics in Soup Creek are due primarily to the introduction of nonnative salmonids. Existing impacts to bull trout in Soup Creek include an imminent moderate to high impact due to the propagation of lake trout in the drainage and a low impact due to hybridization with eastern brook trout. Existing impacts to westslope cutthroat trout include a likely moderate impact due to introgression from rainbow trout hybridization and a moderate impact from displacement by eastern brook trout (where the 2 species' distributions overlap below the migration-barrier falls).

- **Soup Creek Habitat – Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS.*) The analysis of hydrologic data for Soup Creek indicates that the existing average departure in flow regime is approximately 1.0 percent above the range of naturally occurring conditions (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

Changes in flow regime can affect bull trout and westslope cutthroat trout fisheries through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish habitat variables. As a consequence, the likelihood is very low for very low existing direct and indirect impacts to these habitat characteristics as a result of the estimated 1.0-percent increase in flow regime to Soup Creek within the project area.

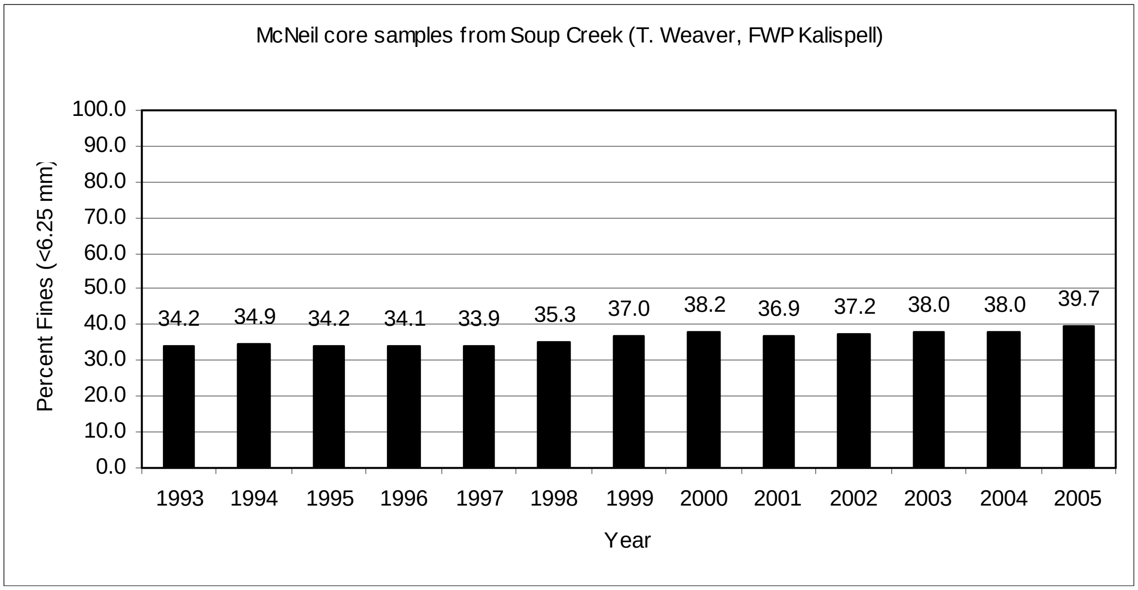
Changes in flow regime have been known to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, the likelihood is very low for very low existing direct and indirect impacts to native and nonnative fish species as a result of flow regime modifications to Soup Creek within the project area.

- **Soup Creek Habitat – Sediment**

Existing stream sediment processes that are described in this analysis are the *Rosgen* stream morphological type, sediment budget, and streambank stability. The stream morphology of 4 separate reaches of Soup Creek within the project area (see *FIGURE E-2 – THREE CREEKS TIMBER SALE PROJECT: SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) is described using the *Rosgen* river classification (*Rosgen 1996*). From the confluence with the Swan River (river mile 0.00) upstream to river mile 6.80 (Reach 1), the creek exhibits a ‘C4’ channel type; from river mile 6.80 to 7.45 (Reach 2), the creek exhibits a ‘B3’ channel type; from river mile 7.45 to 9.51 (Reach 3), the creek exhibits a ‘A3’ channel type; and from river mile 9.51 upstream to the Forest Service property boundary at river mile 10.37 (Reach 4), the creek exhibits a ‘B4’ channel type. The C morphological type broadly includes meandering streams with both riffles and pools in low-gradient, broad, alluvial valley bottoms (*Rosgen 1996*). More specifically, the C3 morphological type is indicative of gravel-dominated systems with well-developed floodplains. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B3 and B4 morphological types are characteristic of channel compositions dominated by cobbles and gravels, respectively (*Rosgen 1996*). The A3 morphological type includes streams with steep, entrenched, confined channels that are dominated by cobbles with lesser amounts of boulders, gravel, and sand.

Several different surveys have been conducted to describe the sediment budget of Soup Creek, including *McNeil* core, substrate score, and *Wolman* pebble count. The *McNeil* core sampling methodology (*McNeil and Ahnell 1964*) has been demonstrated to be an effective technique for measuring temporal changes in the streambed permeability of spawning gravels. *McNeil* core data has been collected in Soup Creek in a known bull trout spawning reach (NE1/4NE1/4 of Section 19, T24N, R17W) between 1993 and 2005 (see *TABLE E-19 – MCNEIL CORE SAMPLES FROM SOUP CREEK, 1993 THROUGH 2005*). *Weaver and Fraley (1991)* found that the percentage of substrates less than 6.35 millimeters in spawning beds was inversely proportional to bull trout and westslope cutthroat trout embryo survival in the Flathead River basin. The FBC, a cooperative program involving private, State, and Federal landowners in the river basin, subsequently determined that streams with spawning gravels having 35 or 40 percent of substrates less than 6.35 millimeters in any give year were “threatened” or “impaired”, respectively, in regards to bull trout and westslope cutthroat trout embryo survival *(FBC 1991*). *McNeil* core sample results from Soup Creek are collected using *Weaver and Fraley (1991)* and displayed in *TABLE E-19 – MCNEIL CORE SAMPLES FROM SOUP CREEK, 1993 THROUGH 2005* to show the proportion of substrates less than 6.35 millimeters in size. Data from 1993 through 1997 shows that the proportion of substrates less than 6.35 millimeters is under the 35-percent threshold for “threatened” status. However, data from 1998 through 2005

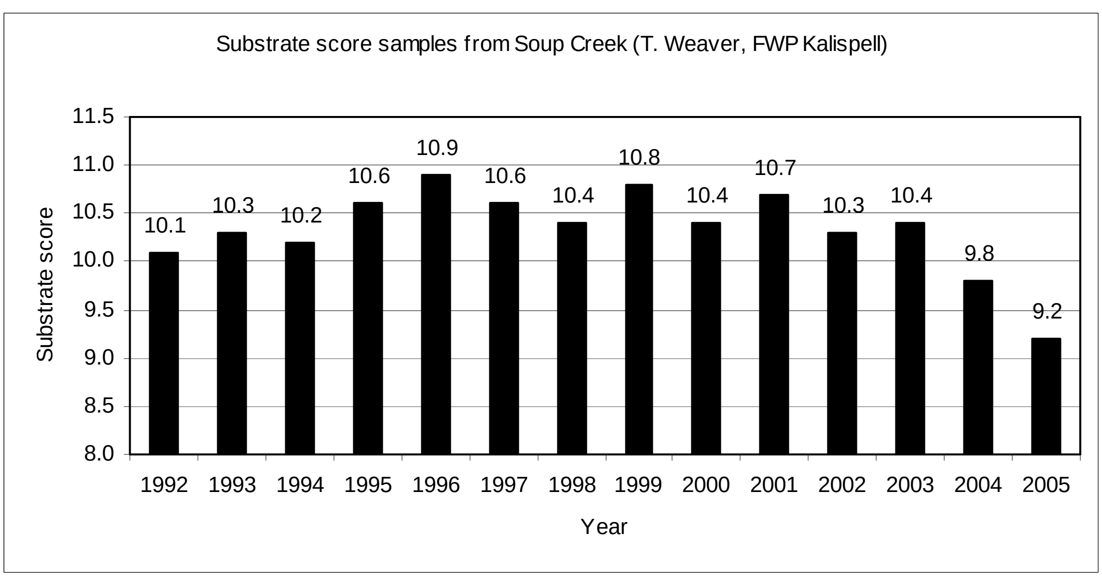
TABLE E-19 – MCNEIL CORE SAMPLES FROM SOUP CREEK, 1993 THROUGH 2005



indicates that the proportion of substrates less than 6.35 millimeters are over 35 percent, which indicates a "threatened" status in respect to bull trout and westslope cutthroat trout embryo survival. The data set from 1998 through 2005 may also indicate an increasing trend in the quantity of substrates less than 6.35 millimeters in size.

Embeddedness is generally described as the degree to which fine sediments surround coarse substrates on the streambed surface (*Sylte and Fischenich 2002*). The substrate score is one technique for measuring embeddedness, where higher scores indicate lower embeddedness and typically better juvenile bull trout habitat (*Shepard et al 1984*). A modified substrate score methodology (*Weaver and Fraley 1991* citing others) has been employed on Soup Creek from 1992 through 2004 (see *TABLE E-20 – SUBSTRATE SCORE SAMPLES FROM*

TABLE E-20 – SUBSTRATE SCORE SAMPLES FROM SOUP CREEK, 1992 THROUGH 2005

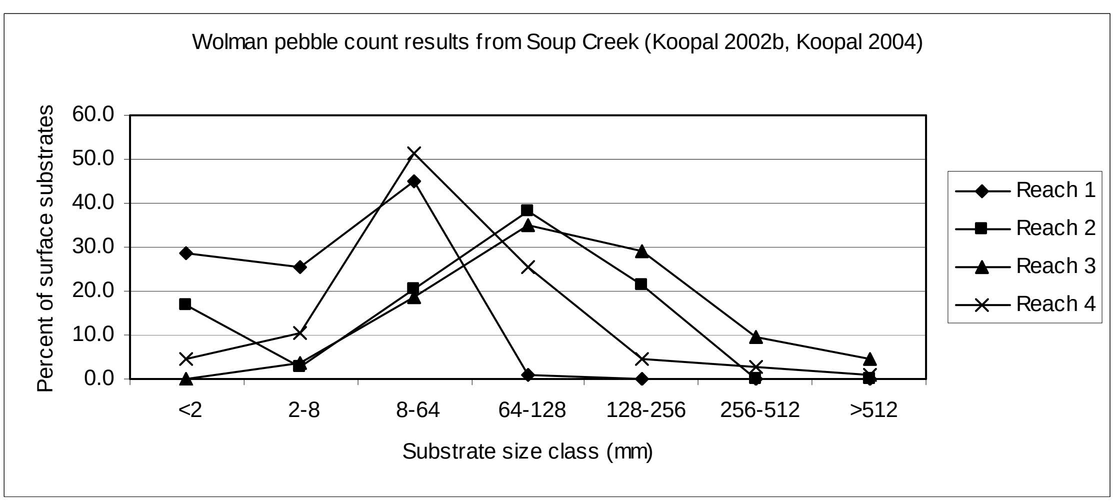


SOUP CREEK, 1992 THROUGH 2005) in a known juvenile bull trout rearing reach (NW1/4NW1/4 of Section 20, T24N, R17W). The FBC has subsequently determined that streams with substrate scores less than 10 or 9 in any given year were “threatened” or “impaired”, respectively, in regards to juvenile bull trout rearing habitat (*FBC 1991*). All of the sample sets in this table show substrate scores higher than 10, except for 2004 and 2005. The scores of 9.8 in 2004 and 9.2 in 2005 are indicating a “threatened” status in respect to juvenile bull trout habitat quality for that year. The substrate score data from 1998 through 2005, which corresponds to those years when *McNeil* core readings have exceeded 35 percent, may also indicate a decreasing trend in substrate score, or conversely, increasing embeddedness due to fine substrates.

The *Wolman* pebble count (*Wolman 1954*) is another method that can be used to describe temporal changes in substrate size classes on the streambed surface. Sample data from Reaches 1 through 4 on Soup Creek (see *FIGURE E-2 – THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) is available from 2002 and 2004 (see *TABLE E-21 – WOLMAN PEBBLE COUNT RESULTS FROM SOUP CREEK, 2002 [REACHES 1 AND 2] AND 2004 [REACHES 3 AND 4]*). Within Reach 1, the combined percentage of substrates less than 8 millimeters is 54.1 percent. When this value is considered in conjunction with a *McNeil* core reading of 37.2 percent (*2002*), this indicates that fine substrates are well distributed on both the surface and subsurface of the streambed in Reach 1. The *Wolman* pebble count results from Reaches 2 through 4 are within the expected ranges of conditions for the associated morphological types.

The final assessment of stream sediment processes includes a description of streambank stability. Streambank stability is a measure of bank-erosion rates per stream length, and changes in the rates can be used as one indicator of potential existing impacts to fish habitats. Streambank-stability data for Soup Creek is available for the years 2002 (Reaches 1 and 2) and 2004 (Reaches 3 and

TABLE E-21 – WOLMAN PEBBLE COUNT RESULTS FROM SOUP CREEK, 2002 (REACHES 1 AND 2) AND 2004 (REACHES 3 AND 4)



4) and includes all stream habitats from the confluence with Swan River (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 10.37) (see *TABLE E- 22 – STREAMBANK STABILITY RESULTS FROM SOUP CREEK [KOOPAL 2002B, KOOPAL 2004]*). The protocol used for collecting the streambank-stability data is that outlined in *Overton et al (1997).* Overall, the results of this data set show very high levels (99.59 to 100 percent) of streambank stability through Reaches 1 through 4 in the project area.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the Soup Creek drainage are considered unspecified, collective effects. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of *EXISTING CONDITIONS* of this analysis.)

The most recent *McNeil* core data (*1998 through 2005*) indicates that the substrates of known spawning reaches are "threatened", and the substrate scores from 2004 and 2005 describing streambed substrate embeddedness also indicates that known bull trout rearing habitat is "threatened". The *Wolman* pebble counts also suggest that high levels of fine (less than 8 millimeters) streambed surface substrates are in Reach 1. On the contrary, a recent streambank-stability assessment in Reach 1 shows very low levels of potential streambank erosion, a natural source of sedimentation. Reasons for the measured levels of fine substrates in Reach 1 may include land-management-related activities, natural cycles in sediment-transport processes, drought-related low seasonal flows, or a combination of two or more of these and other factors. As 3 historic, native-material bridges are in the process of failing within Reaches 3 and 4, land-management-related activities cannot be conclusively ruled out as a potential source of a portion of fine substrates found in Reach 1. In general, however, measurements of substrate within Reaches 2 through 4 are within the expected ranges of conditions for the respective morphological stream type. Based on these observations, low to moderate direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat are likely in Soup Creek.

- **Soup Creek Habitat – Channel Forms**

Two descriptions of channel formation will also be used to describe existing bull trout and westslope cutthroat trout

TABLE E-22 – STREAMBANK STABILITY RESULTS FROM SOUP CREEK (KOOPAL 2002B,

REACH	BANK LENGTH (FEET)		PERCENT STABLE BANK	PERCENT UNSTABLE BANK	PERCENT UNDERCUT BANK
	LEFT	RIGHT	MEAN	MEAN	MEAN
1	36,100.0	36,165.0	99.59	0.41	3.18
2	3,440.0	3,433.0	99.85	0.15	2.77
3	10,897.0	10,919.0	100.00	0.00	2.63
4	4,560.0	4,542.0	100.00	0.00	1.51

habitat in South Fork Lost Creek: *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream gradient of Reach 1 (see *FIGURE E-2 – THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) primarily ranges from 1 to 2 percent, from 3 to 5 percent in Reaches 2 and 4, and from 7 to 8 percent in Reach 3. The stream formations of Reaches 1, 2 and 4 are broadly described as exhibiting ‘forced pool-riffle’, ‘step-pool’, ‘forced step-pool’, and ‘plane bed’ *Montgomery/Buffington* classifications. The ‘forced pool-riffle’ channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). ‘Forced step-pool’ channel forms are also generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:1 to 1:4 and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The ‘step-pool’ is similar to the ‘forced step-pool’ classification, but the formations are primarily sediment dependent as opposed to large-woody-debris dependent. The ‘plane bed’ channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*). The stream formations of Reach 3 are broadly described as exhibiting ‘step-pool’ and ‘cascade’ *Montgomery/Buffington* classifications. The ‘cascade’ channel form generally occurs in steeper channels where longitudinal and lateral disorganization of cobbles and boulders typically prevent the development of large pools (*Montgomery and Buffington 1997*).

The *R1/R4 Fish Habitat Standard Inventory* is a useful protocol for describing detailed existing conditions and tracking temporal changes in the relative proportions of different stream microhabitats used by bull trout, westslope cutthroat trout, and other native fisheries. Inventory data for Soup Creek is available for the years 2002 and 2004 (see *TABLE E-23 – R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUP CREEK [KOOPAL 2002B, KOOPAL 2004])* and includes all stream habitats from the confluence with the Swan River (river mile

TABLE E-23 – R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUP CREEK (KOOPAL 2002B, KOOPAL 2004)

REACH	HABITAT TYPE	TOTAL NUMBER OF UNITS	MEAN HABITAT LENGTH (FEET)	MEAN WIDTH (FEET)	MEAN HABITAT DEPTH (FEET)	MEAN WIDTH/ DEPTH RATIO	MEAN HABITAT AREA (SQUARE FEET)	MEAN HABITAT VOLUME (CUBIC FEET)
1	Fast	318	96.4	11.2	0.36	34.92	1,082.8	389.1
1	Slow	193	27.2	15.7	1.04	16.59	426.9	444.9
2	Fast	35	84.0	12.3	0.33	37.52	1,034.9	346.1
2	Slow	17	18.4	15.4	1.03	15.44	283.6	289.5
3	Fast	90	96.9	15.0	0.47	33.41	1,452.8	679.2
3	Slow	78	27.4	14.4	0.94	16.34	395.2	370.7
4	Fast	42	87.9	11.7	0.29	41.99	1,025.1	299.3
4	Slow	42	19.8	13.6	0.79	18.17	270.2	212.3

0.00) upstream through the project area and to the end of Reach 4 (river mile 10.37) (see *FIGURE E-2 – THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*). In order to simplify the description of existing conditions, detailed habitat data from Reaches 1 through 4 has been consolidated into fast and slow habitat types. Fast habitats include stream features such as cascades, high and low gradient riffles, runs, and glides. Slow habitats include dammed pools, lateral scour pools, midchannel scour pools, plunge pools, and step pools. Bull trout and westslope cutthroat trout utilize all of the habitat types with varying frequency throughout the different life stages, although long-term persistence within a stream by all life stages of each species is generally limited by the amount and frequency of different slow habitat types. Increasing amounts of different pool habitats are typically proportional to increasing levels of bull trout and westslope cutthroat trout stream-habitat quality.

The following existing conditions can be deduced from the 2002 and 2004 habitat inventories:

- The habitat data for Reach 1 indicates that 62 percent of all channel forms are fast-type habitat features, and the remaining 38 percent of all channel forms are slow-type habitat features; approximately 19 percent of the total reach area includes slow-type habitat features, and approximately 41 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 2 indicates that 67 percent of all channel forms are fast-type habitat features, and the remaining 33 percent of all channel forms are slow-type habitat features; approximately 12 percent of the total reach area includes slow-type habitat features, and approximately 29 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 3 indicates that 54 percent of all channel forms are fast-type habitat features, and the remaining 46 percent of all channel forms are slow-type habitat features; approximately 19 percent of the total reach area includes slow-type habitat features, and approximately 32 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 4 indicates that 50 percent of all channel forms are fast-type habitat features, and the remaining 50 percent of all channel forms are slow-type habitat features; approximately 21 percent of the total reach area includes slow-type habitat features, and approximately 42 percent of the total reach volume is in slow-type habitat features.

This information portrays Reaches 1 and 4 as having relatively high proportions of slow, or pool, habitat features and Reaches 2 and 3 as having relatively lower proportions of pool habitat features. It can also be inferred that Reaches 1 and 4 have relatively higher levels of channel complexity, in-stream cover, and potential wintering habitat. Considering reach gradients, valley location, and geomorphological processes, the observed proportions of habitat types for

each reach are within the broad ranges of expected conditions.

No specific conclusions regarding trends in channel form can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing specific trends in channel forms, no direct and indirect impacts to the channel form component of bull trout and westslope cutthroat trout habitat are apparent in Soup Creek.

- **Soup Creek Habitat – Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream-nutrient inputs, and other variables (*Hansen et al 1995*). This section will consider the following important existing conditions of the riparian area: stand type, site potential tree height, and stream shading.

The predominant riparian stand types along Soup Creek within the project area include various grand fir and Engelmann spruce series. Although grand fir and Engelmann spruce are typically the dominant species during late seral and climax stages, other species such as subalpine fir, Douglas-fir, western larch, and Sitka alder are also components of the overstory (*Hansen et al 1995*). Furthermore, the riparian stand type as it relates to the associated geology and soils can be classified as exhibiting NL2A (Reach 1 only), SL2B, and SL3B characteristics, which primarily occur adjacent to B and C channel types with stream gradients ranging from 1 to 12 percent (*Sirucek and Bachurski 1995*). The NL2A riparian landtype generally occurs at sites with deep, weakly developed, very gravelly sandy loams or very gravelly loams (*Sirucek and Bachurski 1995*). Where the SL2B and SL3B riparian landtypes occur with the stand types described above, expected conditions are somewhat poorly drained sites with deep, weakly developed, gravely or bouldery, sandy loams or loams (*Sirucek and Bachurski 1995*).

Specific riparian stand conditions adjacent to Soup Creek were assessed in 2004 through 6 riparian forest surveys in Sections 26 and 27, T24N, R17W ("Lower Soup Riparian Cruise") and 6 riparian forest surveys in Section 25, T24N, R17W ("Upper Soup Riparian Cruise"). During the surveys, all trees (live and dead) with a dbh were recorded. Results of the "Lower Soup Riparian Cruise" surveys indicate that the quadratic mean diameter of riparian trees is 5.9 inches, the average number of trees per acre is 1,032, and the average basal area per acre is 195.9 square feet. Results of the "Upper Soup Riparian Cruise" surveys indicate that the quadratic mean diameter of riparian trees is 8.5 inches, the average number of trees per acre is 262, and the average basal area per acre is 104.2 square feet. Based on data reflecting relatively low quadratic mean diameters and basal areas from the two separate surveys, a relatively low frequency of large trees in the riparian areas of Soup Creek is likely within the project area.

Studies of large-woody-debris recruitment to the stream

channel suggest that the primary zone of recruitment is equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site potential tree height of dominant and co-dominant trees at 100 years (*ARM 36.11.425[5]*) is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest units in Sections 25, 26, and 27, T24N, R17W. The site potential tree height calculated during the "Lower Soup Riparian Cruise" surveys is approximately 83 feet, and the site potential tree height calculated during the "Upper Soup Riparian Cruise" surveys is approximately 74 feet. The calculations of each measure are displayed in *TABLE E-24 – CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("LOWER SOUP RIPARIAN CRUISE")* and *TABLE E-25 – CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("UPPER SOUP RIPARIAN CRUISE")*.

Riparian areas also provide stream shading, which contributes to the regulation of stream temperature regimes by intercepting direct solar radiation to the stream channel. During winter seasons, riparian

TABLE E-24 – CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("LOWER SOUP RIPARIAN CRUISE")*

SAMPLE	SPECIES	HEIGHT (FEET)	AGE (YEARS)	SITE INDEX (BEST FIT)	SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	MEAN SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	REFERENCE
Lower, 1	Grand fir	42	105	30	91		USFS RN-71
Lower, 2	Engelmann spruce	30	61	25	43		USFS RN-42
Lower, 3	Grand fir	52	101	30	91		USFS RN-71
Lower, 4	Grand fir	23	54	30	91		USFS RN-71
Lower, 5	Grand fir	35	88	30	91		USFS RN-71
Lower, 6	Grand fir	32	57	30	91		USFS RN-71
Average value for "Lower Soup Riparian Cruise"						83	

**During July 2004, DNRC personnel took samples from random dominant and co-dominant trees with average growth at a distance of 50 feet from the bankfull slope break.*

TABLE E-25 – CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("UPPER SOUP RIPARIAN CRUISE")*

SAMPLE	SPECIES	HEIGHT (FEET)	AGE (YEARS)	SITE INDEX (BEST FIT)	SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	MEAN SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	REFERENCE
Upper, 1	Douglas-fir	45	42	50	69		USFS RN-47
Upper, 2	Engelmann spruce	64	96	45	69		USFS RN-42
Upper, 3	Engelmann spruce	66	66	55	82		USFS RN-42
Upper, 4	Engelmann spruce	71	79	55	82		USFS RN-42
Upper, 5	Douglas-fir	72	109	50	69		USFS RN-47
Average value for "Upper Soup Riparian Cruise"						74	

**During July 2004, DNRC personnel took samples from random dominant and co-dominant trees with average growth at a distance of 50 feet from the bankfull slope break.*

areas may also function to regulate stream temperatures by inhibiting temperature loss through evaporation, convection, or long-wave radiation from the stream (*Beschta et al 1987*). The degree to which a riparian area blocks direct solar radiation to the stream can be determined by measuring the angular canopy density, which is a function of riparian tree species composition, stand age, and tree density (*Beschta et al 1987*). Samples of angular canopy density were taken at 4 locations from the center of Soup Creek during 2004, and measurements were taken for the months of July and August (the months during which direct solar radiation has the greatest potential effect on stream temperature regimes). Results of these measurements indicate that the existing riparian tree vegetation blocks an average of 63 percent of direct solar radiation during July and an average of 75 percent of direct solar radiation during August.

Past disturbance in the riparian areas of Soup Creek include the random, selective harvesting of large trees up to approximately 30 years ago. Based on the relatively low frequency of large trees in the "Lower Soup Riparian Cruise" and "Upper Soup Riparian Cruise" data sets, this level of past random, selective riparian harvesting likely represents a potential low existing impact. The potential existing impacts are low since the result of the past associated action poses an existing low risk of reduced recruitable large woody debris over the foreseeable near future.

Potential low direct and indirect impacts to the riparian function component of bull trout and westslope cutthroat trout habitat exist in Soup Creek.

- **Soup Creek Habitat – Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is a critical component in the formation of complex habitat for bull trout and westslope cutthroat trout. All life stages of bull trout and westslope cutthroat trout have been observed closely associating with large woody debris in the Flathead River basin (*Pratt 1984, Shepard et al 1984*). Large-woody-debris recruitment rates to Soup Creek throughout the project area can be described using large-woody-debris counts per stream length, and this data was collected during 2002 and 2004 as part a *R1/R4 Fish Habitat Standard Inventory (Overton et al 1997*) (see *TABLE E-26 – LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUP CREEK (KOOPAL 2002B, KOOPAL 2004)*. Large-woody-debris counts for Soup Creek include all stream habitats from the beginning of Reach 1 (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 10.37).

Data from reference reaches (*Harrelson et al 1994*) throughout the Flathead River basin region indicates that the expected frequency of large woody debris in undisturbed A channels ranges from 62 to 332 pieces per 1,000 feet, from 74 to 172 pieces per 1,000 feet in undisturbed B channels, and from 1 to 121 pieces per 1,000 feet in undisturbed C channels (*Bower 2004*). This data suggests that the existing frequency of large woody debris in Reaches 1 through 4 of Soup Creek are within the expected range of frequencies when compared to

TABLE E-26 – LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUP CREEK (KOOPAL 2002B, KOOPAL 2004)

REACH	CHANNEL TYPE	TOTAL REACH LENGTH (FEET)	TOTAL NUMBER OF SINGLE PIECES	TOTAL NUMBER OF PIECES IN AGGREGATES	TOTAL NUMBER OF ROOT WADS	TOTAL PIECES OF LARGE WOODY DEBRIS IN REACH	NUMBER OF PIECES PER 1,000 FEET
1	C	35,926	551	3,118	42	4,246	118
2	B	3,427	59	213	7	279	81
3	A	10,859	201	910	3	1,114	103
4	B	4,525	72	371	3	446	99

reference reaches in the region with similar morphological characteristics.

No apparent direct and indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat exist in Soup Creek.

- **Soup Creek Habitat – Stream Temperature**

Stream temperature data for Soup Creek is available for 2001, 2003, 2004, and 2005 and is displayed in *TABLE E-27 – STREAM TEMPERATURE DATA FOR SOUP CREEK*. *FIGURE E-3 – THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM TEMPERATURE LOGGERS* displays the locations of stream temperature data recorders on Soup Creek.

The stream temperature data indicates that the annual maximum weekly maximum temperature at the water-quality sample site has ranged from 15.6 to 19.0 degrees Celsius for the years 2001, 2003, 2004, and 2005. During these years the maximum seasonal temperature recorded at the water-quality sample site was 16.3 degrees Celsius during 2001, 19.4 degrees Celsius during 2003, 19.1 degrees Celsius during 2004, and 18.1 degrees Celsius during 2005. For comparison, a maximum seasonal temperature of 16.1 degrees Celsius was recorded during 1983 approximately 1,500 feet upstream of the water-quality sample site (*Leathe et al 1985*). A comparison to the 1983 temperature data may suggest

*TABLE E-27 – STREAM-TEMPERATURE DATA FOR SOUP CREEK**

SITE NAME	MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS)	WARMEST DAY OF MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS)		DAYS GREATER THAN		
		DATE	MAXIMUM	10.0	15.0	21.1
				CELSIUS		
Soup_NWLO_WQsite_2001	15.6	07/11/01	16.3	101	23	0
Soup_NWLO_WQsite_2003	19.0	07/23/03	19.4	98	60	0
Soup_NWLO_WQsite_2004	18.2	07/16/04	19.1	92	48	0
Soup#1_Lower_2004	10.5	07/15/04	11.0	26	0	0
Soup#2_Middle_2004	9.6	07/16/04	10.1	3	0	0
Soup#3_Upper_2004	10.2	08/17/04	10.7	7	0	0
Soup_NWLO_WQsite_2005	17.9	08/06/05	18.1	109	40	0
Soup#1_Lower_2005	10.0	08/06/05	10.1	10	0	0
Soup#2_Middle_2005	9.2	08/06/05	9.3	0	0	0
Soup#3_Upper_2005	8.8	08/06/05	8.9	0	0	0

**Samples obtained by DNRC resource specialists using Water Temp Pro (Onset Corporation) data loggers.*

that the maximum seasonal temperatures within Reach 1 of Soup Creek during 2003 and 2004 are potentially slightly above average.

Rates of change in stream temperature are typically variable between different stream segments, as rates of change in stream temperature are generally a function of variations in stream shading, aspect, stream volume, net radiation, evaporation, convection, conduction, groundwater interactions, and inputs from tributaries (*Beschta et al 1987*). During 2004, the rate of change in maximum weekly maximum stream temperature between Soup#3 and Soup#2 is approximately –0.3 degrees Celsius per half mile, +0.5 degrees Celsius per half mile between Soup#2 and Soup#1, and +0.7 degrees Celsius per half mile between Soup#1 and Soup_NWLO_WQsite. During 2005, the rate of change in maximum weekly maximum stream temperature between Soup#3 and Soup#2 is approximately +0.2 degrees Celsius per half mile, +0.4 degrees Celsius per half mile between Soup#2 and Soup#1, and +0.7 degrees Celsius per half mile between Soup#1 and Soup_NWLO_WQsite. Inputs from cooler groundwater likely influenced the stream temperature regime between Soup#3 and Soup#2 during 2004, where the maximum weekly maximum stream temperature dropped appreciably at the rate of approximately 0.3 degrees Celsius per half mile. The reason for the approximate increase of 0.2 degrees Celsius per half mile between Soup#3 and Soup#2 during 2005 is unclear, except that there may be fluctuations in groundwater interception between Soup#3 and Soup#2 from year to year. Groundwater interactions are known to affect many of the streams in the Swan River valley (*Baxter 1997, Stanford and Ward 1993*), and the stream temperature effects of groundwater interactions likely occur periodically in other reaches of Soup Creek. However, the extent to which different groundwater interactions affect stream temperatures is generally a function of a multitude of site-specific variables and not consistent across drainages.

In respect to bull trout, some of the temperature ranges described in *TABLE E-27 – STREAM-TEMPERATURE DATA FOR SOUP CREEK* are not within the species' tolerances, as observed in various studies. *Fraley and Shepard (1989)* rarely observed juvenile bull trout in streams exceeding 15 degrees Celsius. *Gamett (2002)* did not find bull trout where maximum stream temperatures exceeded 20 degrees Celsius. *Reiman and Chandler (1999)* found that bull trout are most frequently observed in streams having summer maximum temperatures of approximately 13 to 14 degrees Celsius. Reaches 1 and 2 within Soup Creek (see *FIGURE E-2 – THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) are known to provide habitat to bull trout; however, the relatively high seasonal temperatures associated with Reach 1 likely limit potential bull trout use only to fall, winter, and spring. Reach 2 likely provides the only year-round cold-water refugia for bull trout.

Maximum seasonal stream temperatures in Reach 1 of Soup Creek are historically high, and these seasonal maximums are likely a limiting variable to bull trout populations in Soup Creek. The apparent swift increase in seasonal maximum

stream temperature in Reach 1 during 2003 and 2004 may or may not be a result of regular fluctuations in stream temperature regimes. As a result of this uncertainty, the increase in seasonal maximum stream temperature in Reach 1 during 2003 and 2004 represents a potential low existing direct and indirect impact to the stream temperature component of bull trout and westslope cutthroat trout habitat in Reach 1 of Soup Creek. No apparent direct and indirect impacts to the stream temperature component of bull trout and westslope cutthroat trout habitat exist in Reaches 2, 3, and 4 of Soup Creek.

- **Soup Creek Habitat – Connectivity**

Currently 5 bridges cross Soup Creek within and immediately adjacent to the project area in the NE1/4NW1/4 of Section 29, NW1/4SW1/4 of Section 27, NE1/4NE1/4 of Section 26, NW1/4NW1/4 of Section 25, and SE1/4NE1/4 of Section 25, all in T24N, R17W. The bridge crossings in Sections 27 and 29 are the only road-stream crossing structures that exist within bull trout habitat, and these 2 crossings provide full passage of all life stages of bull trout. All 5 bridge crossings provide full passage of all life stages of westslope cutthroat trout.

Several sets of naturally occurring cascades and small waterfalls on Soup Creek in the E1/2 of Section 27 and W1/2 of Section 26 in T24N, R17W, pose complete migration barriers to bull trout. The cascades and small waterfalls also very likely pose complete migration barriers to westslope cutthroat trout, eastern brook trout, and, if present, rainbow trout. Both bull trout and westslope cutthroat trout exist below the barriers, and only westslope cutthroat trout are known to exist upstream of the barriers.

Although the waterfall migration barriers limit bull trout and westslope cutthroat trout migration in Soup Creek, the stream features are naturally occurring and not considered an existing impact. No direct and indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat exist in Soup Creek.

- **Soup Creek – Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the Soup Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE E-28 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUP CREEK*.

One related action includes past and present construction of the existing road system in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The existing road system has been assessed for specific sources of sedimentation to streams in the

TABLE E-28 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUP CREEK

	EXISTING IMPACTS TO BULL TROUT AND WESTSLOPE CUTTHROAT TROUT IN SOUP CREEK
Populations – presence and genetics	Low to high
Habitat – flow regimes	Very low
Habitat – sediment	Low to moderate
Habitat – channel forms	None
Habitat – riparian function	Low
Habitat – large woody debris	None
Habitat – stream temperature	Low
Habitat – connectivity	None
Other related actions	Very low to moderate
Existing collective impacts	*Moderate*

Soup Creek watershed. Estimates indicate that approximately 35.6 tons per year of road material are contributed to streams in the Soup Creek watershed by the existing road system (see *APPRENDIX D – WATERSHED AND HYDROLOGY ANAYLSIS*). The collective effect from the existing road system, as represented by the estimated amount of material contributed to streams, likely represents an existing moderate impact to bull trout and westslope cutthroat trout in Soup Creek.

Other related actions that are considered in the existing collective impacts are very low impacts due to fishing and other related recreational uses and low impacts from past forest-management activities on upstream land ownerships and road and road-stream crossing construction and maintenance activities on upstream land ownerships.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, a moderate collective impact to bull trout and westslope cutthroat trout likely exist in Soup Creek.

ENVIRONMENTAL (ALTERNATIVE) EFFECTS TO FISHERIES

DIRECT AND INDIRECT EFFECTS

The purpose of this analysis is the assessment of potential impacts to cold-water fisheries and fisheries habitat variables within the Three Creeks Timber Sale Project area as a result of implementing any one of the project alternatives. The assessment of environmental effects in this analysis is based, in part, on the assumption that recommendations (see *FISHERIES ANALYSIS SPECIALIST RECOMMENDATIONS at the end of this document*) will be implemented through the *TIMBER SALE CONTRACT* specifications and monitoring.

In each of the following subsections this assessment will describe the risk of an impact occurring. A low risk means that the impact is unlikely to occur; a moderate risk

indicates that the impact may or may not (50/50) occur; and a high risk means that impact is likely to occur. A very low impact means that the impact is unlikely to be detectable or measurable, and the impact is not likely to be detrimental to the resource. A low impact means that the impact is likely to be detectable or measurable, but the impact is not likely to be detrimental to the resource. A moderate impact means that the impact is likely to be detectable or measurable, but the impact may or may not (50/50) be detrimental to the resource. A high impact means that the impact is likely to be detectable or measurable, and the impact is likely to be detrimental to the resource.

- **Populations – Presence and Genetics**

  - ***Direct and Indirect Effects of No-Action Alternative A on Populations – Presence and Genetics***

    No direct or indirect impacts would occur to bull trout, westslope cutthroat trout, or other fisheries population presence or genetics in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternatives B, C, D, and E on Populations – Presence and Genetics***

    EXISTING CONDITIONS describes the current levels of direct and indirect adverse impacts to bull trout, westslope cutthroat trout, or other fisheries population presence or genetics in South Fork Lost, Cilly, Unnamed, or Soup creeks. These existing levels of impacts are low to high in South Fork Lost Creek; moderate to high in Cilly Creek; none in Unnamed Creek; and low to high in Soup Creek. The existing impacts to native and other fisheries presence and genetics in the project area are primarily the result of displacement, predation, and genetic introgression.

    Examples of actions that may negatively affect bull trout, westslope cutthroat trout, or other fisheries population presence or genetics in the project area include the introduction of nonnative fish species, targeted fish suppression or other removal, stocking, and species introduction to previously uninhabited stream reaches. No actions associated with this alternative involve the direct or indirect manipulation of species population presence or genetics in the project area. Therefore, as a result of the selection of any action alternative, no direct and indirect impacts to bull trout, westslope cutthroat trout, or other fisheries population presence or genetics would be expected in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described in *EXISTING CONDITIONS*. Analysis of bull trout and, in some cases, westslope cutthroat trout populations through redd counts are expected to continue as part of fisheries monitoring in the project area.

- **Habitat – Flow Regimes**

  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Flow Regimes***

    No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of flow regime in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B on Habitat – Flow Regimes***

Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

An analysis of the proposed actions related to Action Alternative B indicates that the resulting cumulative increase in water yields would be 1.8 percent in South Fork Lost Creek, 9.1 percent in Cilly Creek, 5.3 percent in Unnamed Creek, and 3.1 percent in Soup Creek (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-29 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 0.6- to 6.8-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 4.8 to 6.8 percent increases and consequent potential adverse effects in Unnamed and Cilly creeks, respectively, may have a minor detectable and measurable effect to native and nonnative fisheries in that stream. The potential adverse effects in the Cilly and Unnamed creeks may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative B are expected to have a very low risk of very low direct and indirect impacts to the fisheries-habitat variable of flow regime in the South Fork Lost and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly and Unnamed creeks. These potential impacts

TABLE E-29 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B

STREAM BASIN	EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE B
South Fork Lost Creek	0.6
Cilly Creek	6.8
Unnamed Creek	4.8
Soup Creek	2.1

to the fisheries-habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Flow Regimes***

Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

An analysis of the proposed actions related to Action Alternative C indicates that the resulting cumulative increase in water yields would be 1.7 percent in South Fork Lost Creek, 8.6 percent in Cilly Creek, 5.0 percent in Unnamed Creek, and 2.5 percent in Soup Creek (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-30 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 0.5- to 6.3-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 4.5- to 6.3-percent increases and consequent potential adverse effects in Unnamed and Cilly creeks, respectively, may have a minor detectable and measurable effect to native and nonnative fisheries in that stream. The potential adverse effects in Cilly and Unnamed creeks may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative C are expected to have a very low risk of very low direct and indirect impacts to the fisheries-habitat variable of flow regime in South Fork Lost

TABLE E-30 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C

STREAM BASIN	**EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE C**
South Fork Lost Creek	0.5
Cilly Creek	6.3
Unnamed Creek	4.5
Soup Creek	1.5

and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly and Unnamed creeks. These potential impacts to the fisheries-habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Flow Regimes***

  Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

  An analysis of the proposed actions related to Action Alternative D indicates that the resulting cumulative increase in water yields would be 2.5 percent in South Fork Lost Creek, 11.5 percent in Cilly Creek, 5.7 percent in Unnamed Creek, and 2.1 percent in Soup Creek (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-31 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

  The expected 1.1- to 9.2-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 5.2- to 9.2-percent increases and consequent potential adverse effects in Unnamed and Cilly creeks, respectively, may have a minor detectable and measurable effect to native and nonnative fisheries in that stream. The potential adverse effects in Cilly and Unnamed creeks may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

  With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the

TABLE E-31 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D

STREAM BASIN	**EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE D**
South Fork Lost Creek	1.3
Cilly Creek	9.2
Unnamed Creek	5.2
Soup Creek	1.1

selection of Action Alternative D are expected to have a very low risk of very low direct and indirect impacts to the fisheries-habitat variable of flow regime in South Fork Lost and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly and Unnamed creeks. These potential impacts to the fisheries-habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Flow Regimes***

Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

An analysis of the proposed actions related to Action Alternative E indicates that the resulting cumulative increase in water yields would be 2.4 percent in South Fork Lost Creek, 12.1 percent in Cilly Creek, 3.8 percent in Unnamed Creek, and 1.9 percent in Soup Creek (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-32 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 0.9- to 9.8-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost, Unnamed, and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 9.8-percent increase and consequent potential adverse effects in Cilly Creek may have a minor detectable and measurable impact to native and nonnative fisheries in that stream. The potential adverse effects in Cilly Creek may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

TABLE E-32 – EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E

STREAM BASIN	EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE E
South Fork Lost Creek	1.2
Cilly Creek	9.8
Unnamed Creek	3.3
Soup Creek	0.9

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative E are expected to have a very low risk of very low direct and indirect impact to the fisheries-habitat variable of flow regime in South Fork Lost, Unnamed, and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly Creek. These potential impacts to the fisheries-habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- **Habitat – Sediment**
  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Sediment***

No direct or indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment in South Fork Lost, Cilly, Unnamed, or Soup creeks would be expected beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternative B on Habitat – Sediment***

EXISTING CONDITIONS considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate score data, *Wolman* pebble count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of windthrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D – WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative B has a very low to low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes.

APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS also indicates that all road-stream crossing modifications associated with Action Alternative B would reduce sedimentation by up to approximately 19.3 tons per year in South Fork Lost Creek, 1.0 ton per year in Cilly Creek, and 33.7 tons per year in Soup Creek. These proposed modifications represent an approximate 98-, 35-, and 95-percent, respectively, maximum reduction in annual sediment

delivery from existing roads. Road-modification activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout, westslope cutthroat trout, or other fisheries habitat. However, these road modifications would provide a long-term, greatly reduced level of impact to bull trout, westslope cutthroat trout, or other fisheries habitat in respect to sediment.

New road stream crossings installed as part of Action Alternative B may lead to a disproportionate increase in the quantities of fine-sediment size classes in fish-bearing streams and non-fish-bearing connected tributaries. Three new road stream crossings would be installed on a non-fish-bearing reach of Unnamed Creek. Two of the three new road stream crossings are expected to have a moderate risk of both short- and long-term moderate direct and indirect impacts (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*) to the sediment component of fish habitat in downstream fish-bearing reaches of Unnamed Creek. Due to beaver dam complexes and intermittent flows in Unnamed Creek, downstream impacts to Soup Creek are expected to be very limited in risk and potential effect.

In-stream sediment size classes may be affected through inputs from the root wads of windthrown trees adjacent to the stream channel. Sediment inputs from the windthrown root wads of adjacent trees occur throughout unmanaged stream channels; however, in some cases, this process may be exacerbated by increased levels of windthrown trees as a result of riparian timber-harvesting actions. Sediment inputs through this mechanism may lead to a disproportionate increase in the quantities of fine sediment size classes in fish-bearing streams and non-fish-bearing-connected tributaries. The riparian landtypes where riparian harvesting is expected to occur along the fish-bearing reaches of South Fork Lost and Soup creeks include SL2B and SL3B (see *EXISTING CONDITIONS*). Both landtypes are susceptible to windthrow since the shallow water tables typically found in these areas restrict root penetration (*Sirucek and Bachurski 1995*). Furthermore, *Hansen et al (1995)* describes the western red cedar/oak fern (South Fork Lost Creek) and grand fir and Engelmann spruce (Soup Creek) riparian stand types as being susceptible to high levels of windthrow. Considering the expected extent of riparian harvesting, landtypes, and riparian stand types, a low risk of very low direct and indirect impacts to the sediment component of fish habitats throughout the project area are expected as a result of potential sedimentation from the root wads of windthrown trees.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types, and geology (landtype), and increases in adjacent hill slope. *APPENDIX G – SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology.

According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily moderate to high risk of erosion. *TABLE E-33 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G – SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. In *TABLE E-33 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B*, 35 percent is utilized as a descriptive value since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with an increased risk of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvest-related activities. Considering the erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts

TABLE E-33 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B

	STREAM BASIN			
	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35-percent slope gradient	10.8	14.8	10.2	23.9
Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient	7.9	7.4	5.2	14.6
Range of slope gradients (percent) Within proposed harvest units and within 100 feet of Class 1 and 2 streams	1 to 55	7 to 76	4 to 88	3 to 95
Average slope gradient (percents) within proposed harvest units and within 100 feet of Class 1 and 2 streams	36	28	29	32

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

to the sediment component of fisheries habitat are expected throughout the project area as a result of potential sedimentation from riparian disturbances.

As a result of the selection of Action Alternative B, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries-habitat component of sediment is expected in South Fork Lost, Cilly, and Soup creeks. An overall moderate risk of moderate direct and indirect impacts to the fisheries-habitat component of sediment is expected in Unnamed Creek. This assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Sediment***

EXISTING CONDITIONS considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate score data, *Wolman* pebble count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of windthrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D – WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative C has a very low to low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes. The impacts to the sediment component of fisheries habitat in the project area due to road-stream crossing removals, new road stream crossings, and root wads of windthrown trees are also expected to be the same as those described in Action Alternative B.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types and geology (landtype), and increases in adjacent hill slope. *APPENDIX G - SOILS*

ANALYSIS provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily low to high risk of erosion. *TABLE E-34 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G - SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. Thirty-five percent is utilized as a descriptive value in this table since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with increased risks of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvest-related activities. Considering the erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat throughout the project area is expected as a result of potential sedimentation from riparian disturbance.

TABLE E-34 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C*

	STREAM BASIN			
	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35-percent slope gradient	1.6	22.8	10.2	2.8
Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient	3.5	6.7	5.2	2.9
Range of slope gradients (percent) within proposed harvest units and within 100 feet of Class 1 and 2 streams	13 to 90	2 to 76	4 to 88	8 to 91
Average slope gradient (percents) within proposed harvest units and within 100 feet of Class 1 and 2 streams	48	23	29	39

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

As a result of the selection of Action Alternative C, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries-habitat component of sediment is expected in South Fork Lost, Cilly, and Soup creeks. An overall moderate risk of moderate direct and indirect impacts to the fisheries-habitat component of sediment is expected in Unnamed Creek. This assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative C is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Sediment***

EXISTING CONDITIONS considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate score data, *Wolman* pebble count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of windthrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D – WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative D has a very low to low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes.

APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS also indicates that all road-stream crossing modifications associated with Action Alternative D would reduce sedimentation by up to approximately 18.7 tons per year in South Fork Lost Creek, 0.6 tons per year in Cilly Creek, and 33.6 tons per year in Soup Creek. These proposed modifications represent an approximate 94 percent, 22 percent, and 95 percent, respectively, maximum reduction in annual sediment delivery from existing roads. Road-modification activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-

term impact to bull trout, westslope cutthroat trout, or other fisheries habitat. However, these road modifications would provide a long-term, greatly reduced level of impact to bull trout, westslope cutthroat trout, or other fisheries habitat in respect to sediment.

New road-stream crossings installed as part of Action Alternative D may lead to a disproportionate increase in the quantities of fine sediment size classes in fish-bearing streams and non-fish-bearing-connected tributaries. Two new road-stream crossings would be installed on a non-fish-bearing reach of Cilly Creek, and 3 new road-stream crossings would be installed on a non-fish-bearing reach of Unnamed Creek. One of the two new road-stream crossings on Cilly Creek and two of the three new road-stream crossings on Unnamed Creek are expected to have a moderate risk of both short- and long-term moderate direct and indirect impacts (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*) to the sediment component of fish habitat in downstream fish-bearing reaches of Cilly and Unnamed creeks. Due to beaver dam complexes and intermittent flows in Unnamed Creek, downstream impacts to Soup Creek are expected to be very limited in risk and potential effect.

The impacts to the sediment component of fisheries habitat in the project area due to the root wads of windthrown trees are expected to be the same as those described in Action Alternative B.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types and geology (landtype), and increases in adjacent hill slope. The *APPENDIX G – SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily moderate to high risk of erosion. *TABLE E-35 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G – SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. Thirty-five percent is utilized as a descriptive value in this table since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with increased risks of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to

TABLE E-35 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D*

	STREAM BASIN			
	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35-percent slope gradient	11.5	16.0	10.2	1.9
Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient	14.1	12.5	5.2	4.2
Range of slope gradients (percent) within proposed harvest units and within 100 feet of Class 1 and 2 streams	1 to 148	8 to 83	4 to 88	5 to 79
Average slope gradient (percents) within proposed harvest units and within 100 feet of Class 1 and 2 streams	40	33	29	42

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

streams from adjacent timber-harvest-related activities. Considering erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat is expected throughout the project area as a result of potential sedimentation from riparian disturbance.

As a result of the selection of Action Alternative D, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries-habitat component of sediment is expected in South Fork Lost and Soup creeks. An overall moderate risk of moderate direct and indirect impacts to the fisheries-habitat component of sediment is expected in Cilly and Unnamed creeks. This assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Sediment***

EXISTING CONDITIONS considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate score data, *Wolman* pebble count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat

have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of windthrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D – WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative E has a very low to low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes.

APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS also indicates that all road-stream crossing modifications associated with Action Alternative E would reduce sedimentation by up to approximately 18.7 tons per year in South Fork Lost Creek, 0.6 tons per year in Cilly Creek, and 33.9 tons per year in Soup Creek. These proposed modifications represent an approximate 94-, 35-, and 95-percent, respectively, maximum reduction in annual sediment delivery from existing roads. Road-modification activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout, westslope cutthroat trout, or other fisheries habitat. However, these road modifications would provide a long-term, greatly reduced level of impact to bull trout, westslope cutthroat trout, or other fisheries habitat in respect to sediment.

New road-stream crossings installed as part of Action Alternative E may lead to a disproportionate increase in the quantities of fine sediment size classes in fish-bearing streams and non-fish-bearing-connected tributaries. One new road-stream crossing would be installed on a non-fish-bearing reach of Unnamed Creek. The new road-stream crossing is expected to have a low risk of both short- and long-term low direct and indirect impacts (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*) to the sediment component of fish habitat in downstream fish-bearing reaches of Unnamed Creek. Due to beaver dam complexes and intermittent flows in Unnamed Creek, downstream impacts to Soup Creek are expected to be very limited in risk and potential effect.

The impacts to the sediment component of fisheries habitat in the project area due to the root wads of windthrown trees are expected to be the same as those described in Action Alternative B.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types and geology (landtype), and increases in adjacent hill slope. *APPENDIX G - SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily moderate to high risk of erosion. *TABLE E-36 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G – SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. Thirty-five percent is utilized as a descriptive value in this table since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with increased risk of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. SMZ laws are designed to provide

TABLE E-36 – CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E*

	STREAM BASIN			
	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35-percent slope gradient	6.8	36.4	9.1	11.5
Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient	24.4	9.4	0.5	6.0
Range of slope gradients (percent) within proposed harvest units and within 100 feet of Class 1 and 2 streams	9 to 122	1 to 92	4 to 69	5 to 79
Average slope gradient (percents) within proposed harvest units and within 100 feet of Class 1 and 2 streams	52	22	16	30

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvesting-related activities. Considering the erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat is expected throughout the project area as a result of potential sedimentation from riparian disturbance.

As a result of the selection of Action Alternative E, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment is expected. The risk assessment applies to fisheries in South Fork Lost, Cilly, Unnamed, and Soup creeks, and the assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative E is selected for implementation.

- **Habitat – Channel Forms**

  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Channel Forms***

No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of channel forms in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternatives B and C on Habitat – Channel Forms***

As described in *EXISTING CONDITIONS*, no direct or indirect impacts to the channel form component of bull trout, westslope cutthroat trout, and other fisheries habitat are apparent in South Fork Lost, Cilly, Unnamed, and Soup creeks. Potential changes to stream channel forms are primarily a function of modifications to flow regimes and consequent relationships with existing sediment size classes (*Montgomery and Buffington 1997*). Adverse impacts to flow regimes and existing sediment size classes may affect channel forms by shifting the relative quantities of slow and fast habitat features. The likely manifestation of this type of adverse impact is a decrease in the total volume of slow habitat features and an increase in the total volume of fast habitat features. This shift in channel forms may lead to a reduction in the quantity of rearing and wintering habitat available to bull trout, westslope cutthroat trout, and other fisheries.

As indicated in the risk assessment for flow regime, a very low risk of very low impacts is expected in South Fork Lost and Soup creeks and a low risk of low impacts is expected in Cilly and Unnamed creeks. As indicated in the risk assessment for sediment, a low risk of low impacts is expected in the South Fork Lost, Cilly, and Soup creeks and a moderate risk of moderate impacts is expected in Unnamed Creek. A comparable, or overall low risk of low direct and indirect impacts to channel forms is expected in South Fork Lost, Cilly, and Soup creeks as a result of implementing an action alternative. A moderate risk of low direct and indirect impacts to channel forms is expected in Unnamed Creek. The assumptions derived from this portion of the project analysis

are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if an action alternative is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative D on Habitat - Channel Forms***

The results of risk assessments for flow regime and sediment are similar to those identified in Action Alternative B, except a moderate risk of moderate impacts is expected for the sediment component of fish habitat in Cilly Creek. As a result of the selection of Action Alternative D, the anticipated direct and indirect impacts to the fisheries habitat variable of channel forms in South Fork Lost and Soup creeks are expected to be the same as those described for Action Alternative B. A moderate risk of low direct and indirect impacts to channel forms is expected in both Cilly and Unnamed creeks. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E on Habitat - Channel Forms***

As indicated in the risk assessment for flow regime, a very low risk of very low impacts is expected in South Fork Lost, Cilly, and Soup creeks and a low risk of low impacts is expected in Unnamed Creek. As indicated in the risk assessment for sediment, a low risk of low impacts is expected in South Fork Lost, Cilly, Unnamed, and Soup creeks. A comparable, or overall low risk of low direct and indirect impacts to channel forms is expected in South Fork Lost, Cilly, and Soup creeks as a result of implementing an action alternative. A moderate risk of low direct and indirect impacts to channel forms is expected in Unnamed Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if an action alternative is selected for implementation.

♦ **Habitat – Riparian Function**

- ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Riparian Function***

No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of riparian function in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B on Habitat – Riparian Function***

EXISTING CONDITIONS describes low levels of direct and indirect impacts to the riparian function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

The proposed action associated with Action Alternative B that could further affect riparian function is selective riparian harvesting. Specific variables of riparian function that may be affected by the selective

riparian harvesting are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

Action Alternative B proposes a selective riparian harvest adjacent to approximately 2,950 feet of South Fork Lost Creek in in Unit 8 in Section 3, T24N, R17W; this harvest lies entirely south of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer of 25 feet from the nearest bankfull edge of South Fork Lost Creek; from 25 feet to 95 feet, a maximum of 50 percent of trees 8 inches dbh or greater would be harvested. The proposed selective riparian harvest, which would extend approximately 2,950 feet, is representative of approximately 3 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

The riparian stand type along South Fork Lost Creek (western red cedar/oak fern) is likely to remain after implementing the riparian harvest prescription. (The western red cedar/oak fern stand type is named after the climax vegetation community.) However, as grand fir comprises a considerable proportion of the existing low and midlevel riparian tree vegetation along South Fork Lost Creek, this species will likely become co-dominant throughout the forthcoming climax stages within the riparian area. Growth of early successional tree species of the existing stand type, such as western larch and western white pine, are expected to remain minor components of the riparian species composition. However, the postharvest site preparation for proposed Unit 8, in Section 3, T24N, R17W, may promote the growth of more western larch and western white pine and less western red cedar and grand fir.

EXISTING CONDITIONS describes levels of potentially recruitable large woody debris from the riparian area along South Fork Lost Creek as a quadratic mean diameter of 9.1 inches, an average of 764 trees (live and dead standing) per acre, and an average basal area per acre of 346.0 square feet. After modifying the riparian cruise data to simulate the residual stand conditions subsequent to implementing the proposed riparian harvest prescription, the expected levels of potentially recruitable large woody debris would (1) remain the same from the nearest bankfull edge of South Fork Lost Creek to 25 feet, and (2) from 25 to 95 feet would include a quadratic mean diameter of 7.7 inches, an average of 674 trees per acre, and an average basal area per acre of 217.6 square feet. The estimated trees per acre in the area between 25 and 95 feet from the bankfull edge of the stream would drop approximately 12 percent, but this fraction of trees would also represent an approximate 37 percent reduction of basal area per acre within the same area. Windthrow and windsnap within the riparian area is likely to increase above existing levels after implementing the proposed riparian harvest prescription. These events may further reduce the residual standing trees per acre and basal area within the riparian area.

The general probability of a riparian tree providing in-stream large woody debris (as part of riparian function) is a result of many variables, such

as distance from the stream, height of the tree, other riparian trees that may deflect fall direction, tree bole breakage, riparian sideslope gradient, and prevailing local storm winds. Furthermore, determining the probability of a particular tree size class contributing to in-stream large woody debris is a function of additional variables such as average growth rates of different species, susceptibilities to windthrow and windsnap, species canopy density, the average heights of different species, and different species' responses to disease and shade. The analysis of these scenarios and variables is beyond the scope of this environmental assessment. However, the results of a simple quantitative analysis will follow based on the typical characteristics of 100-year-old index trees found through site review are summarized below. (The details of this simple quantitative analysis can be found in a separate document in the project file: *FISHERIES ANALYSIS OF RIPARIAN FUNCTION – SIMPLE QUANTITATIVE ANALYSIS OF 100-YEAR-OLD TREES.*) The 100-year-old index tree is an appropriate indicator since the tree may represent an average piece of residual recruitable large woody debris throughout a foreseeable riparian management zone entry cycle.

The proposed riparian harvest prescription is expected to decrease the proportion of potentially recruitable 100-year-old trees to the 2,950-foot reach of South Fork Lost Creek by approximately 3 percent. Although notable, based on the riparian cruise data, the basal area equivalent of this proportion of riparian trees is comparable to 61.5 square feet per acre or approximately 18 percent of the existing basal area per acre.

The estimated 3-percent reduction in potentially recruitable 100-year-old trees carries a moderate level of error, as errors associated with the data collection, sampling error, and probability formulas were not factored. The true value is also likely higher considering an existing road prism is north of South Fork Lost Creek, which certainly eliminates a small portion of potentially recruitable 100-year-old trees. The value is also a snapshot in time, and the estimated reduction is expected to be negligible after trees of smaller diameter grow into the eligible size criteria used in this assessment. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

By establishing the outer boundary of the RMZ at 95 feet in accordance with *ARM 36.11.425 (5)* and implementing the proposed riparian harvest prescription, the majority of riparian trees that currently grow between 77 and 95 feet from the nearest bankfull edge of South Fork Lost Creek will also be retained. Seventy-seven feet is the effective height of an average 100-year-old co-dominant riparian tree bole that comprises potentially recruitable large wood debris (*Robinson and Beschta 1990*). A portion of these trees will undoubtedly be greater than 100 years old and exhibit effective heights taller than 77 feet for additional potentially recruitable large woody debris.

Reductions in recruitable large woody debris from the riparian

area may affect native and nonnative fish by altering in-stream large woody debris frequency (see *Habitat – Large Woody Debris*).

EXISTING CONDITIONS describes levels of shading (angular canopy density) in South Fork Lost Creek during peak summer months. Existing riparian tree vegetation blocks an average of 65 percent of direct solar radiation during July and an average of 81 percent of direct solar radiation during August. Potential changes to stream shading during peak summer months after implementing the proposed riparian harvest prescription are a function of many variables, such as residual canopy density, residual crown characteristics, sideslope gradients, and residual species composition. Although a numerical prediction would, therefore, contain a high degree of uncertainty, broad generalizations can be applied to estimate potential effects. A compilation of related literature (*Castelle and Johnson 2000*) found that a 49-foot buffer provides approximately 85 percent of the maximum shade available for small streams, a 56-foot buffer provides approximately 90 percent of the maximum available angular canopy density, and a 79-foot buffer typically provides the maximum available shading to a stream. The proposed selective riparian harvest would occur entirely to the south of South Fork Lost Creek, which includes the riparian area providing the bulk of existing stream shading. Considering this data and the proposed riparian harvest prescription, which includes a no-cut buffer from the nearest bankfull edge of South Fork Lost Creek out to 25 feet and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 95 feet, a maximum reduction in angular canopy density is expected to be 20 percent during the months of July and August. This estimated reduction in shading is also expected to become negligible as the riparian area between 25 feet and 95 feet regenerates to preharvest conditions. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

Reductions in shading by the riparian area may affect native and nonnative fish primarily by altering the stream temperature (see *Habitat – Stream Temperature*).

Other proposed harvest units that are adjacent to South Fork Lost Creek include Units 15 and 19 in Section 4, Unit 5 in Section 3, and Unit 3 in Section 1, all in T24N, R17W. These 4 proposed units are located at least 140 feet from South Fork Lost Creek and are not expected to affect riparian functions.

The relocation of USFS Road 680 would allow the riparian area occupied by the original road prism north of the stream to recover over an extended period of time. This recovery zone in the South Fork Lost Creek riparian area is expected to provide a minor increase in the long-term amount of potentially recruitable large woody debris and shading to the stream.

After an assessment of potential effects, which includes:

- an affected area equal to approximately 3 percent of the total riparian area adjacent to bull trout or westslope cutthroat trout habitat,

- no foreseeable adverse effects to stand type (such as shifts in stand type),
- a relatively minor reduction in potentially recruitable large woody debris, and
- an estimated maximum reduction in stream shading of 20 percent,

an overall moderate risk of low direct and indirect impacts to the riparian function component of fish habitat are expected in South Fork Lost Creek.

No proposed harvest units are adjacent to fish-bearing reaches of Cilly and Unnamed creeks. A selective riparian harvest in accordance with the SMZ Law and Rules for Class 1 streams would occur along approximately 59 percent (6,470 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek and along approximately 68 percent (3,830 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not expected to have adverse impacts to stand types, such as shifts in stand type, and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

Action Alternative B also proposes selective riparian harvesting adjacent to approximately 5,890 combined feet of Soup Creek in proposed Units 5 and 11 in Section 27, (‘Lower’ Soup area) and Units 12 and 13 in Section 25 (‘Upper’ Soup Area), all in T24N, R17W, which lie entirely north of the stream channel with the exception of one 140-foot reach south of the stream. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet and harvesting a maximum of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. (Although the site potential tree height within the ‘Lower’ Soup area [83 feet] surpasses that found in the ‘Upper’ Soup area [74 feet], the data from the ‘Lower’ Soup area will be applied to the proposed riparian harvest prescriptions throughout the main Soup Creek drainage.) The proposed selective riparian harvest, which would extend approximately 5,890 feet, is representative of approximately 6 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

The riparian stand types along Soup Creek (various grand fir and Engelmann spruce series) are likely to remain after implementing the riparian harvest prescription. Other early and late successional tree species of the existing stand type, such as Douglas-fir and subalpine fir, are expected to remain minor components of the riparian species composition.

EXISTING CONDITIONS describes levels of potentially recruitable large woody debris from the riparian area along ‘Lower’ Soup Creek as a quadratic mean diameter of 5.9 inches, an average of 1,032 trees per acre, and an average basal area per acre of 195.9 square feet. After modifying the riparian cruise data in this area to simulate the residual stand conditions subsequent to implementing the proposed riparian harvest prescription, the expected levels of potentially recruitable large woody debris would (1) remain the same from the nearest bankfull edge of Soup Creek to

25 feet, and (2)from 25 to 83 feet would include a quadratic mean diameter of 4.9 inches, an average of 962 trees per acre, and an average basal area per acre of 123.6 square feet. The estimated trees per acre in the area between 25 and 83 feet from the bankfull edge of the stream would drop approximately 7 percent, but this fraction of trees would also represent an approximate 37-percent reduction of basal area per acre within the same area. Windthrow and windsnap within the riparian area would likely increase above existing levels after implementing the proposed riparian harvest prescription. These events may further reduce the residual trees per acre and basal area within the 'Lower' Soup Creek riparian area.

EXISTING CONDITIONS describes levels of potentially recruitable large woody debris from the riparian area along 'Upper' Soup Creek as a quadratic mean diameter of 8.5 inches, an average of 262 trees per acre, and an average basal area per acre of 104.2 square feet. After modifying the riparian cruise data in this area to simulate the residual stand conditions subsequent to implementing the proposed riparian harvest prescription, the expected levels of potentially recruitable large woody debris would (1) remain the same from the nearest bankfull edge of Soup Creek to 25 feet, and (2) from 25 to 83 feet would include a quadratic mean diameter of 7.1 inches, an average of 212 trees per acre, and an average basal area per acre of 58.8 square feet. The estimated trees per acre in the area between 25 and 83 feet from the bankfull edge of the stream would drop approximately 19 percent, but this fraction of trees would also represent an approximate 44-percent reduction of basal area per acre within the same area. Windthrow and windsnap within the riparian area is likely to increase above existing levels after implementing the proposed riparian harvest prescription. These events may further reduce the residual trees per acre and basal area within the 'Upper' Soup Creek riparian area.

Similar to the assessment of rates of potential large-woody-debris recruitment previously described for South Fork Lost Creek within this section, the results of a simple quantitative analysis for the 'Lower' and 'Upper' Soup Creek riparian areas will follow based on the typical characteristics of 100-year-old index trees found through site review. (The details of this simple quantitative analysis can be found in a separate document in the project file: *FISHERIES ANALYSIS OF RIPARIAN FUNCTION – SIMPLE QUANTITATIVE ANALYSIS OF 100-YEAR-OLD TREES*.) The 100-year-old index tree is an appropriate indicator since the tree may represent an average piece of residual recruitable large woody debris throughout a foreseeable riparian management zone entry cycle.

The proposed riparian harvest prescription is expected to decrease the proportion of potentially recruitable 100-year-old trees to the 2,480-foot reach ('Lower' Soup) of Soup Creek by approximately 4 percent. Based on the riparian cruise data, the basal-area equivalent of this proportion of riparian trees is comparable to 55.3 square feet per acre, or approximately 28 percent of the existing basal area per acre.

The proposed riparian harvest prescription is expected to decrease the proportion of

potentially recruitable 100-year-old trees to the 3,410-foot reach (‘Upper’ Soup) of Soup Creek by approximately 6 percent. Based on the riparian cruise data, the basal-area equivalent of this proportion of riparian trees is comparable to 32.8 square feet per acre or approximately 32 percent of the existing basal area per acre.

The estimated 4- and 6-percent reductions in potentially recruitable 100-year-old trees to ‘Lower’ and ‘Upper’ Soup Creek riparian areas, respectively, carries a moderate level of error, as errors associated with the data collection, sampling error, and probability formulas were not factored. The true value is also likely higher considering existing road prisms are north of Soup Creek, which certainly eliminates a small portion of potentially recruitable 100-year-old trees. The value is also a snapshot in time, and the estimated reduction is expected to be negligible after trees of smaller diameter grow into the eligible size criteria used in this assessment. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

By establishing the outer boundary of the RMZ at 83 feet, in accordance with *ARM 36.11.425 (5)* and implementing the proposed riparian harvest prescription, the majority of riparian trees that currently grow between 51 (‘Lower’ Soup area) and 58 feet (‘Upper’ Soup area) and 83 feet from the nearest bankfull edge of Soup Creek will also be retained. Fifty-one and 58 feet are the effective heights of an average 100-year-old co-dominant riparian tree bole that comprises potentially recruitable large woody debris (*Robinson and Beschta 1990*). A portion of these trees will undoubtedly be greater than 100 years old and exhibit effective heights taller than 51 and 58 feet for additional potentially recruitable large woody debris.

EXISTING CONDITIONS describes levels of shading (angular canopy density) in Soup Creek during peak summer months. Existing riparian tree vegetation blocks an average of 63 percent of direct solar radiation during July and an average of 75 percent of direct solar radiation during August. Potential changes to stream shading during peak summer months after implementing the proposed riparian harvest prescription are a function of many variables, such as residual canopy density, residual crown characteristics, sideslope gradients, and residual species composition. Although a numerical prediction would, therefore, contain a high degree of uncertainty, broad generalizations can be applied to estimate potential effects. A compilation of related literature (*Castelle and Johnson 2000*) found that a 49-foot buffer provides approximately 85 percent of the maximum shade available for small streams, a 56-foot buffer provides approximately 90 percent of the maximum available angular canopy density, and a 79-foot buffer typically provides the maximum available shading to a stream. The proposed selective riparian harvest would occur almost entirely to the north of Soup Creek, which includes the riparian area providing the least amount of existing stream shading. Considering this data and the proposed riparian

harvest prescription, which includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet, a maximum reduction in angular canopy density of 5 percent is expected during the months of July and August. This estimated reduction in shading is also expected to become negligible as the riparian area between 25 and 83 feet regenerates to preharvest conditions. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

Unit 19 in Section 27, T24N, R17W is also adjacent to Soup Creek, though this proposed unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

After an assessment of potential effects, which includes:

– an affected area equal to approximately 6 percent of the total riparian area adjacent to bull trout or westslope cutthroat trout habitat,
– no foreseeable adverse effects to stand type (such as shifts in stand type),
– a relatively minor reduction in potentially recruitable large woody debris, and
– an estimated maximum reduction in stream shading of 5 percent,

an overall moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat are expected in Soup Creek.

As a result of implementing Action Alternative B, a moderate risk of low direct and indirect impacts to the riparian-function component of fisheries habitat is expected within South Fork Lost, Cilly, Unnamed, and Soup creeks. The low expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Riparian Function***

EXISTING CONDITIONS describes low levels of direct and indirect impacts to the riparian function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

The proposed action associated with Action Alternative C that could further affect riparian function is a selective riparian harvest. Specific variables of riparian function that may be affected by the selective riparian harvest are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

The relocation of USFS Road 680 would allow the riparian area occupied by the original road prism north of the stream to recover over an extended period of time. This recovery zone in the South Fork Lost Creek riparian area is expected to provide a minor increase in the long-term amount of potentially

recruitable large woody debris and shading to the stream.

Action Alternative C does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14, 15, 19, 20, and 22 in Section 4 and Unit 5 in Section 3, all in T24N, R17W, are adjacent to South Fork Lost Creek. These 6 proposed units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian functions of standtype composition, the quantity of recruitable large woody debris within the site potential tree height, and stream shading. As a result of selecting Action Alternative C, no foreseeable, or otherwise detectable, adverse direct and indirect impacts to the riparian function component of fish habitat are expected in South Fork Lost Creek.

Action Alternative C proposes selective riparian harvesting adjacent to approximately 650 feet of Cilly Creek in proposed Unit 23 in Section 16, T24N, R17W, which spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet, in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 650 feet, is representative of approximately 3 percent of the total linear riparian area adjacent to the reaches of the stream that currently provide habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include potential moderately reduced levels of recruitable large woody debris and reduced levels of stream shading.

A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 49 percent (5,350 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek. This upstream harvest is expected to have no adverse impacts to stand types (such as a shift in stand type) and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Cilly Creek, which includes:

- an affected area equal to approximately 3 percent of the total riparian area adjacent to eastern brook trout habitat,
- a potential moderate reduction in recruitable large woody debris to the fish-bearing reach,
- a potential moderate reduction in stream shading to the fish-bearing reach, and
- a potential moderate reduction in stream shading to the non-fish-bearing reach,

a moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat are expected in that stream.

No proposed harvest units are adjacent to the fish-bearing reaches of Unnamed Creek. A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 68 percent (3,830 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not

expected to have any adverse impacts to stand types and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Unnamed Creek, which includes a potential moderate reduction in stream shading to the non-fish-bearing reach, a moderate risk of low direct and indirect impacts to the riparian function component of fish habitat are expected in that stream.

Action Alternative C proposes a selective riparian harvest adjacent to approximately 140 combined feet of Soup Creek in proposed Unit 11 in Section 27, T24N, R17W (‘Lower’ Soup area), which lies entirely south of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. The proposed selective riparian harvest, which would extend approximately 140 feet, is representative of approximately one-tenth of 1 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Due to the very limited spatial extent of the proposed action, a detailed analysis of potential effects to riparian function, such as described in Action Alternative B, will not be conducted in this section. Foreseeable adverse effects to riparian-type recruitable large woody debris and stream shading in Soup Creek are expected to be very minor if Action Alternative C is implemented.

Proposed Unit 19 in Section 27, T24N, R17W, is also adjacent to Soup Creek. This unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

After an assessment of potential effects, which includes:

- an affected area equal to approximately one-tenth of 1 percent of the total riparian area adjacent to bull trout or westslope cutthroat trout habitat,
- no foreseeable adverse effects to stand type (such as a shift in stand type),
- a relatively very minor reduction in potentially recruitable large woody debris, and
- an estimated very minor reduction in stream shading,

an overall very low risk of very low direct and indirect impacts to the riparian-function component of fish habitat are expected in Soup Creek.

As a result of implementing Action Alternative C, a moderate risk of low direct and indirect impacts to the riparian-function component of fisheries habitat are expected within Cilly and Unnamed creeks. A very low risk of very low direct and indirect impacts to the riparian-function component of fisheries habitat are expected within South Fork Lost and Soup creeks. The potential low and very low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Riparian Function***

  EXISTING CONDITIONS describes low levels of direct and indirect impacts to the riparian function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

  The proposed action associated with Action Alternative D that could further affect riparian function is selective riparian harvesting. Specific variables of riparian function that may be affected by the selective riparian harvest are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

  Action Alternative D proposes a selective riparian harvest adjacent to approximately 2,950 feet of South Fork Lost Creek in proposed Unit 8 in Section 3, T24N, R17W. The location and extent of the proposed action is identical to that described in Action Alternative B. Proposed Unit 22 of Section 4, Unit 5 of Section 3, and Unit 3 of Section 1, all in T24N, R17W, are also adjacent to South Fork Lost Creek. These 3 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian functions of standtype composition, the quantity of recruitable large woody debris within the site potential tree height, and stream shading. As a result of selecting Action Alternative D, effects to the riparian-function component of fish habitat in South Fork Lost Creek are expected to be the same as those described in the detailed analysis of riparian function in Action Alternative B. The results of that detailed analysis indicate an expected moderate risk of low direct and indirect impacts to the riparian function component of fish habitat in South Fork Lost Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

  No proposed harvest units are adjacent to the fish-bearing reaches of Cilly and Unnamed creeks. A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 67 percent (7,260 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek and along approximately 68 percent (3,830 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not expected to have any adverse impacts to stand types (such as shifts in stand type) and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

  Action Alternative D proposes a selective riparian harvest adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W (‘Lower’ Soup area), which lies entirely north of the stream channel. The proposed riparian

harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. The proposed selective riparian harvest, which would extend approximately 2,480 feet, is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

Unit 19 in Section 27, T24N, R17W, is also adjacent to Soup Creek. This unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

Although Action Alternative D does not include Unit 11 in Section 27, T24N, R17W ('Lower' Soup area), which involves a selective harvest adjacent to approximately 140 feet of Soup Creek, the anticipated impacts of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the 'Lower' Soup area. The results of that detailed analysis indicate an expected overall moderate risk of low direct and indirect impacts to the riparian function component of fish habitat in Soup Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

As a result of implementing Action Alternative D, a moderate risk of low direct and indirect impacts to the riparian function component of fisheries habitat are expected within South Fork Lost, Cilly, Unnamed, and Soup creeks. The low expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Riparian Function***

EXISTING CONDITIONS describes low levels of direct and indirect impacts to the riparian function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

The proposed action associated with Action Alternative E that could further affect riparian function is selective riparian harvesting. Specific variables of riparian function that may be affected by the selective riparian harvest are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

The relocation of USFS Road 680 would allow the riparian area occupied by the original road prism north of the stream to recover over an extended period of time. This recovery zone in the South Fork Lost Creek riparian area is expected to provide a minor increase in the long-term amount of potentially recruitable large woody debris and shading to the stream.

Action Alternative E does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units

14 and 21 in Section 4 and Units 5 and 7 of Section 3, all in T24N, R17W, are adjacent to South Fork Lost Creek. These 4 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian functions of standtype composition, the quantity of recruitable large woody debris within the site potential tree height, and stream shading. As a result of selecting Action Alternative E, no foreseeable, or otherwise detectable, adverse direct and indirect impacts to the riparian function component of fish habitat are expected in South Fork Lost Creek.

Action Alternative E proposes a selective riparian harvest adjacent to approximately 1,380 combined feet of Cilly Creek in proposed Units 18 and 23 in Section 16, T24N, R17W, which spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 1,380 feet, is representative of approximately 7 percent of the total linear riparian area adjacent to the reaches of the stream that currently provides habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include potential moderately reduced levels of recruitable large woody debris and reduced levels of stream shading.

A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 49 percent (5,350 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek. This upstream harvest is expected to have no adverse impacts to stand types (such as shifts in stand type) and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Cilly Creek, which includes:

– an affected area equal to approximately 7 percent of the total riparian area adjacent to eastern brook trout habitat,
– a potential moderate reduction in recruitable large woody debris to the fish-bearing reach,
– a potential moderate reduction in stream shading to the fish-bearing reach, and
– a potential moderate reduction in stream shading to the non-fish-bearing reach,

an overall moderate risk of low direct and indirect impacts to the riparian function component of fish habitat is expected in that stream.

No proposed harvest units are adjacent to the fish-bearing reaches of Unnamed Creek. A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 12 percent (650 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not

expected to have adverse impacts to stand types and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, minor reductions in stream shading may have a low impact on stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Unnamed Creek, which includes a potential minor reduction in stream shading to the non-fish-bearing reach, an overall low risk of low direct and indirect impacts to the riparian function component of fish habitat are expected in that stream.

Action Alternative E proposes a selective riparian harvest adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W (‘Lower’ Soup area), which lies entirely north of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. The proposed selective riparian harvest, which would extend approximately 2,480 feet, is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

Unit 19 in Section 27 and Unit 10 in Section 26, T24N, R17W, are also adjacent to Soup Creek. These proposed units are located at least 100 feet from Soup Creek and are not expected to affect riparian functions.

Although Action Alternative E does not include proposed harvest Unit 11 in Section 27, T24N, R17W (‘Lower’ Soup area), which involves a selective harvest adjacent to approximately 140 feet of Soup Creek, the anticipated impacts of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the ‘Lower’ Soup area. The results of that detailed analysis indicate an expected overall moderate risk of low direct and indirect impacts to the riparian function component of fish habitat in Soup Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative E is selected for implementation.

As a result of implementing Action Alternative E, a moderate risk of low direct and indirect impacts to the riparian function component of fisheries habitat are expected in Cilly, Unnamed, and Soup creeks, and a very low risk of very low direct and indirect impacts are expected in South Fork Lost Creek. The potential low and very low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- **Habitat – Large Woody Debris**

  - ***Direct and Indirect Effects of No-Action Alternative A to Habitat – Large Woody Debris***

    No direct or indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of large woody debris would occur in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B to Habitat – Large Woody Debris***

  EXISTING CONDITIONS describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

  The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvesting is the frequency of in-stream large woody debris.

  The assessment of riparian function noted that reduced levels of recruitable large woody debris is expected from approximately 3 percent of the total riparian area adjacent to the fish-bearing reaches of South Fork Lost Creek and approximately 6 percent of the total riparian area adjacent to the fish-bearing reaches of Soup Creek. Furthermore, the actual levels of reduced recruitable large woody debris from the riparian areas adjacent to proposed harvest units are expected to be relatively minor compared to *EXISTING CONDITIONS*. And a simple assessment of index trees at least 100 years old (adjacent to the proposed harvest areas) suggests instantaneous recruitment rates of this tree size class may be reduced by approximately 3 percent in the South Fork Lost Creek proposed harvest unit and 4 to 6 percent in the Soup Creek proposed harvest units. Considering this outcome only, a proportional long-term decrease may occur in in-stream large woody debris, but frequency levels are expected to remain within the ranges of the frequencies found in nearby undisturbed reference reaches (see *EXISTING CONDITIONS*).

  On the contrary, large-woody-debris recruitment to South Fork Lost and Soup creeks through windthrow and windsnap is likely to increase some degree after implementing the proposed riparian harvest prescriptions. This event is likely to occur since prevailing storm winds are typically able to have a greater impact on windthrow and windsnap within riparian buffers when relatively more intensive and adjacent upland harvesting is implemented. The riparian soil conditions adjacent to South Fork Lost and Soup creeks are also conducive to higher levels of windthrow. Considering this outcome only, higher levels of windthrow and windsnap as a result of adjacent timber harvesting are expected to lead to short-term increases in the frequency of in-stream large woody debris to South Fork Lost and Soup creeks.

  A large-woody-debris recruitment model (*Welty et al 2002*) also indicates that higher levels of in-stream large woody debris in South Fork Lost and Soup creeks may result for at least 100 years after implementing the proposed riparian harvest prescriptions. Model results are not easily quantified since the default stand-growth equations are developed for the western Cascades region, and to develop and program project-specific stand-growth equations for the model inputs is beyond the scope of this portion of this analysis. However, after applying the proposed riparian harvest prescriptions, the

default outputs are likely representative of a general trend in large-woody-debris recruitment (and not necessarily the future rates of large-woody-debris recruitment). The potential increased trend in large-woody-debris recruitment is likely due to model assumptions such as an anticipated increase in windthrow and windsnap and stand regeneration within the selective riparian harvest area that may supersede the existing late-seral stocking levels.

No adverse impacts to the large-woody-debris component of fish habitat are anticipated in Cilly and Unnamed creeks since no riparian harvesting is expected adjacent to the fish-bearing reaches of these streams. Primarily due to the relatively small channel sizes, migration of in-stream large woody debris to the fish-bearing reaches from upstream non-fish-bearing reaches (where riparian harvesting would occur) is not expected to be affected.

As a result of implementing Action Alternative B, a low risk of very low direct and indirect impacts to the large-woody-debris component of fisheries habitat within South Fork Lost and Soup creeks are expected. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected within Cilly and Unnamed creeks. The low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if Action Alternative B is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative C to Habitat – Large Woody Debris***

EXISTING CONDITIONS describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvest is the frequency of in-stream large woody debris.

Action Alternative C does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14, 15, 19, 20, and 22 in Section 4 and Unit 5 in Section 3, all in T24N, R17W, are near South Fork Lost Creek. These 6 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian function of providing recruitable large woody debris within the site potential tree height. As a result of selecting Action Alternative C, no foreseeable adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat in South Fork Lost Creek are expected.

Action Alternative C proposes a selective riparian harvest adjacent to approximately 650 feet of Cilly Creek in proposed Unit 23 in Section 16, T24N, R17W; that harvest spans both sides of the stream channel.

The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet, in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 650 feet, is representative of approximately 3 percent of the total linear riparian area adjacent to the reaches of the stream that currently provide habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include reduced levels of recruitable large woody debris. A low risk of low direct and indirect impacts to the in-stream large-woody-debris component of fisheries habitat in Cilly Creek is also expected as a result of implementing Action Alternative C.

Action Alternative C does not propose any selective riparian harvesting adjacent to fish-bearing reaches of Unnamed Creek. As a result of selecting Action Alternative C, no foreseeable adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are expected in Unnamed Creek.

Action Alternative C proposes selective riparian harvesting adjacent to approximately 140 combined feet of Soup Creek in proposed Unit 11 of Section 27, T24, R17W (‘Lower’ Soup area). The proposed selective riparian harvest is representative of approximately one-tenth of 1 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Foreseeable adverse impacts to recruitable large woody debris in Soup Creek are expected to be very minor if Action Alternative C is implemented. A comparable, or very low risk of very direct and indirect impacts to in-stream large woody debris in Soup Creek is also expected as a result of implementing Action Alternative C.

As a result of implementing Action Alternative C, a low risk of low direct and indirect impacts to the large-woody-debris component of fisheries habitat is expected in Cilly Creek, and a very low risk of very low direct and indirect impacts is expected in Soup Creek. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in South Fork Lost and Unnamed creeks. The expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative D to Habitat – Large Woody Debris***

EXISTING CONDITIONS describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvest is the frequency of in-stream large woody debris.

Action Alternative D proposes selective riparian harvesting

adjacent to approximately 2,950 feet of South Fork Lost Creek in proposed Unit 8 in Section 3, T24N, R17W. The location and extent of the proposed action is identical to that described in Action Alternative B. Unit 22 in Section 4, Unit 5 in Section 3, and Unit 3 in Section 1, all in T24N, R17W, are also adjacent to South Fork Lost Creek. These 3 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian function of providing recruitable large woody debris. The spatial extent of anticipated selective riparian harvesting in Action Alternative D is similar or less than that proposed under Action Alternative B. The degree of anticipated selective riparian harvesting in Action Alternative D is also expected to be similar. As a result of selecting Action Alternative D, the potential overall direct and indirect effects to the large-woody-debris component of fisheries habitat within the project area are expected to be the same as those described for Action Alternative B.

No harvest units are proposed adjacent to the fish-bearing reaches of Cilly and Unnamed creeks. As a result of selecting Action Alternative D, foreseeable adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are not expected in Cilly and Unnamed creeks.

Action Alternative D proposes a selective riparian harvest adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W (‘Lower’ Soup area), which lies entirely north of the stream channel. The proposed selective riparian harvest would extend approximately 2,480 feet and is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Proposed Unit 19 in Section 27, T24N, R17W, is also adjacent to Soup Creek. This proposed unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

Although Action Alternative D does not include proposed Unit 11 in Section 27, T24N, R17W (‘Lower’ Soup area), which involves selective riparian harvesting adjacent to approximately 140 feet of Soup Creek, the anticipated effects of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the ‘Lower’ Soup area. The degree of anticipated selective riparian harvest in Action Alternative D is also expected to be similar. As a result of selecting Action Alternative D, the potential overall direct and indirect effects to the large-woody-debris component of fisheries habitat within the project area are expected to be the same as those described for Action Alternative B.

As a result of implementing Action Alternative D, a low risk of very low direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in South Fork Lost and Soup creeks. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in Cilly and Unnamed creeks. The low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this

portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E to Habitat – Large Woody Debris***

EXISTING CONDITIONS describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvest is the frequency of in-stream large woody debris.

Action Alternative E does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14 and 21 in Section 4 and Units 5 and 7 in Section 3, all in T24N, R17W, are near South Fork Lost Creek. These 4 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian function of providing recruitable large woody debris within the site potential tree height. As a result of selecting Action Alternative E, no foreseeable, adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are expected in South Fork Lost Creek.

Action Alternative E proposes selective riparian harvesting adjacent to approximately 1,380 combined feet of Cilly Creek in proposed Units 18 and 23 in Section 16, T24N, R17W, which spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 1,380 feet, is representative of approximately 7 percent of the total linear riparian area adjacent to the reaches of the stream that currently provide habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include reduced levels of recruitable large woody debris. A moderate risk of low direct and indirect impacts to in-stream large woody debris in Cilly Creek is also expected as a result of implementing Action Alternative E.

Action Alternative E does not propose any selective riparian harvesting adjacent to the fish-bearing reaches of Unnamed Creek. As a result of selecting Action Alternative E, no foreseeable, adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are expected in Unnamed Creek.

Action Alternative E proposes selective riparian harvesting adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W (‘Lower’ Soup area), which lies entirely north of the stream channel. The proposed selective riparian harvest, which would extend approximately 2,480 feet, is representative of

approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Unit 19 in Section 27 and Unit 10 in Section 26, all in T24N, R17W, are also adjacent to Soup Creek. These proposed units are located at least 100 feet from Soup Creek and are not expected to affect riparian functions.

Although Action Alternative E does not include proposed Unit 11 in Section 27, T24N, R17W (‘Lower’ Soup area), which involves selective riparian harvesting adjacent to approximately 140 feet of Soup Creek, the anticipated effects of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the ‘Lower’ Soup area. The degree of anticipated selective riparian harvest in Action Alternative E is also expected to be similar. As a result of selecting Action Alternative E, the potential overall direct and indirect effects to the large-woody-debris component of fisheries habitat within the project area are expected to be the same as those described for Action Alternative B.

As a result of implementing Action Alternative E, a moderate risk of low direct and indirect impacts to the large-woody-debris component of fisheries habitat is expected in Cilly Creek, and a low risk of very direct and indirect impacts is expected in Soup Creek. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in South Fork Lost and Unnamed creeks. The expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in Soup Creek as part of future monitoring if Action Alternative E is selected for implementation.

Habitat - Stream Temperature

- ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Stream Temperature***

  No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat components of stream temperature in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B on Habitat – Stream Temperature***

  EXISTING CONDITIONS describes no apparent direct and indirect impacts to the stream temperature component of habitat in South Fork Lost, Cilly, and Unnamed creeks. Potential existing direct and indirect impacts to the stream temperature component of bull trout and westslope cutthroat trout habit may be low in Reach 1 of Soup Creek. No existing direct or indirect impacts to the stream temperature component of bull trout and westslope cutthroat trout habitat are apparent in Reaches 2, 3, and 4 of Soup Creek. Whether the potential low existing direct and indirect impacts in Reach 1 of Soup Creek are from natural conditions or land-management practices is uncertain.

  The primary proposed action associated with this alternative that could adversely affect stream temperature is selective riparian harvesting. Stream

temperature may be affected by the proposed selective riparian harvest through decreases in angular canopy density (shade), sedimentation from increase rates of windthrown root wads, sedimentation from soil disturbances adjacent to riparian areas, and sedimentation from road-stream crossing installations. Sedimentation may directly or indirectly contribute to increases in stream temperature through the aggradations of pool (slow) stream features. The aggradations of pool (slow) stream features may promote increases in stream width-to-depth ratios, which may, consequently, decrease the capacity of a stream to resist changes in temperature. Potential changes in stream temperature are evaluated by assessing the anticipated change in temperature at the reach scale.

Changes in stream temperature in South Fork Lost Creek adjacent to the proposed selective riparian harvest are an issue that will be further analyzed below. Potential impacts to this fisheries-habitat variable in South Fork Lost Creek are likely to be more pronounced than in other fish-bearing streams due to the extent of the proposed selective riparian harvesting that may occur south of the stream.

Moderate levels of selective riparian harvesting are expected to occur in non-fish-bearing reaches of Cilly and Unnamed creeks. These moderate levels of riparian harvesting are expected to have a moderate risk of adverse effects to stream shading in the non-fish-bearing reaches and a consequent low impact to stream temperatures. However, due to disconnected surface flows and known interactions with groundwater sources, the low impact to stream temperatures in the non-fish-bearing reaches of Cilly and Unnamed creeks are also expected to have a low risk of low direct and indirect impacts to the stream temperature component of fish habitat in downstream reaches.

Virtually all of the proposed adjacent selective riparian harvesting would occur on the north side of Soup Creek, which is expected to reduce angular canopy closure (shading) during peak temperatures by an estimated 5 percent. As a result of the minor reduction in shading, a very low risk of very low direct and indirect impacts to the stream temperature component of fish habitat in Soup Creek is expected.

Two widely acknowledged models are utilized to analyze potential changes to stream temperature in South Fork Lost Creek as a result of modifications to angular canopy density (shade). The first model, SSTEMP (*Bartholow 2002*), considers a myriad of stream and riparian variables, including stream input temperatures, hydrology, stream geometry, meteorology, percent shade, other shade factors, and time of year. The second model, described in *Currier and Hughes (1980)* and *Beschta et al (1987)*, is based on a simple relationship between net rate of heat added to the stream, surface area of the stream exposed to solar radiation, and streamflow.

In order to evaluate the potential change in stream temperature through SSTEMP, the proposed selective riparian harvest prescription will be applied to known stream and riparian variables during the peak stream temperature periods

of 2004 and 2005. The initial stream temperature inputs are those recorded at the ‘SFKLost#2_Middle’ station (South Fork Lost Creek) since these are the approximate locations of the adjacent upstream extent of the proposed selective riparian harvest. The estimated reduction in angular canopy closure for South Fork Lost Creek (20 percent) will be used in this model. Weather archives available for Bigfork, Montana (approximately 19 miles northwest of South Fork Lost Creek) will be used for meteorological inputs. (A total of 34 stream and riparian variables are input to the SSTEMP model and a total of 22 stream and riparian variables are input to the *Currier and Hughes [1980]* and *Beschta et al [1987]* model, most of which are derived from field measurements.) The SSTEMP model outputs will estimate the change in stream temperature through the portion of South Fork Lost Creek that is immediately adjacent to the proposed selective riparian harvest (see *TABLE E-37 – ESTIMATIONS OF CHANGE IN STREAM TEMPERTURE ADJACENT TO THE PROPOSED SELECTIVE RIPARIAN HARVEST ALONG SOUTH FORK LOST CREEK*). By using the known stream and riparian variables from 2004 and 2005, the outputs will reflect the predicted average changes in stream temperatures if the proposed selective riparian harvest had occurred during those years.

The potential change in stream temperature as predicted by *Currier and Hughes (1980)* and *Beschta et al (1987)* will also be displayed in *TABLE E-37 – ESTIMATIONS OF CHANGE IN STREAM TEMPERATURE ADJACENT TO THE PROPOSED SELECTIVE RIPARIAN HARVEST ALONG SOUTH FORK LOST CREEK*. These potential changes in stream temperature reflect estimated maximum changes in temperature during late July, immediately following the implementation of the proposed selective riparian harvest prescription.

The predicted changes in stream temperature in South Fork Lost Creek adjacent to the proposed riparian harvest range from +0.4 to +0.5 degrees Celsius. The predicted stream temperature changes developed by SSTEMP for both 2004 and 2005 are +0.3

TABLE E-37 – ESTIMATIONS OF CHANGE IN STREAM TEMPERATURE ADJACENT TO THE PROPOSED SELECTIVE RIPARIAN HARVEST ALONG SOUTH FORK LOST CREEK

	STREAM		
	SOUTH FORK LOST CREEK 2004	**SOUTH FORK LOST CREEK 2005**	**SOUTH FORK LOST CREEK EXISTING**
Estimated total linear distance (feet) of the selective riparian harvest adjacent to fish-bearing reaches	2,950	2,950	2,950
Model	SSTEMP	SSTEMP	C and H, B*
Actual change in stream temperature (degrees) (maximum weekly maximum temperature [Celsius])	+0.2	+0.2	N/A to model
Predicted change in stream temperature (degrees) as a result of implementing selective riparian harvest (Celsius)	+0.5	+0.5	+0.4

**Currier and Hughes (1980) and Beschta et al (1987)*

degrees Celsius above the actual observed changes in stream temperature. The predicted stream temperature change developed by *Currier and Hughes (1980)* and *Beschta et al (1987)* is +0.2 degrees Celsius greater than the actual observed changes in both 2004 and 2005. The predicted changes in stream temperature are expected to be relatively minor and representative of a moderate risk of low direct and indirect impacts to the stream temperature component of fish habitat in South Fork Lost Creek.

As indicated in the risk assessment for sediment, a low risk of low impacts to the sediment component of fisheries habitat is expected in South Fork Lost, Cilly, and Soup creeks, and a moderate risk of moderate impacts is expected in Unnamed Creek. A proportional, or overall low risk of low impacts is expected to the channel forms in South Fork Lost, Cilly, and Soup creeks, and a moderate risk of low impacts is expected in Unnamed Creek. As described above, the aggradations of pool (slow) stream features may promote increases in stream width-to-depth ratios, which may consequently decrease the capacity of a stream to resist changes in temperature. Because of this potential chain of events related to sedimentation and possible shifts in channel forms, a risk of adverse impacts to the stream temperature component of fish habitat is expected in the project area.

As a result of implementing Action Alternative B, an overall low risk of low direct and indirect impacts to the stream temperature component of fisheries habitat is expected in South Fork Lost, Cilly, and Soup creeks. A moderate risk of low direct and indirect impacts is expected in Unnamed Creek. The low impact is above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Stream Temperature***

  The overall anticipated direct and indirect impacts to the stream temperature component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks are expected to be similar or less than those described in Action Alternative B. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative C is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Stream Temperature***

  The overall anticipated direct and indirect impacts to the stream temperature component of fish habitat are expected to be similar or less than those described in Action Alternative B, except a moderate risk of low direct and indirect impacts is expected in Cilly and Unnamed creeks. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Stream Temperature***

  The overall anticipated direct and indirect impacts to the stream temperature component of fish habitat are expected to be similar or less than those described in Action Alternative B, except a low risk of low direct and indirect impacts is expected in Unnamed Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative E is selected for implementation.

♦ **HABITAT – CONNECTIVITY**

- ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Connectivity***

  No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of connectivity in South Fork Lost, Cilly, Unnamed, and Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B on Habitat – Connectivity***

  EXISTING CONDITIONS describes no direct and indirect impacts to the connectivity component of fisheries habitat in South Fork Lost and Soup creeks within the project area. Existing direct and indirect impacts to the connectivity component of fisheries habitat are likely low in Cilly Creek and likely moderate to high in Unnamed Creek.

  Two existing, failing bridge crossings of South Fork Lost Creek within the project area would be fully removed as part of Action Alternative B; these crossings are located in the NW1/4SW1/4 of Section 4 and the NW1/4SE1/4 of Section 2, all in T24N, R17W. Three existing, failing bridge crossings of Soup Creek within and immediately adjacent to the project area would also be fully removed as part of Action Alternative B; these crossings are located in the NE1/4NW1/4 of Section 29, NW1/4NW1/4 of Section 25, and SE1/4NE1/4 of Section 25, all in T24N, R17W. One other existing, failing bridge crossing of Soup Creek would be replaced with a new bridge; this crossing is located in the NE1/4NE1/4 of Section 26, T24N, R17W. The new bridge structure and 5 bridge reclamation sites on South Fork Lost Creek and Soup Creek are expected to provide naturally occurring levels of connectivity to all life stages of native and nonnative fish species.

  Existing direct and indirect impacts to the connectivity component of fisheries habitat in Cilly and Unnamed creeks would not be remediated as part of Action Alternative B.

  As a result of the selection of Action Alternative B, no adverse direct or indirect impacts to the fisheries habitat variable of connectivity in South Fork Lost, Cilly, Unnamed, and Soup creeks would occur beyond those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternatives C, D, and E on Habitat – Connectivity***

  In terms of fisheries connectivity, the associated proposed actions in Action Alternative B are also expected to occur if Action Alternative C, D, or E is selected. As a result of the selection of one of these alternatives, the anticipated risk of direct and indirect impacts to the fisheries habitat variable of connectivity in South Fork Lost,

Cilly, Unnamed, and Soup creeks are expected to be the same as those described for Action Alternative B.

CUMULATIVE EFFECTS

Cumulative impacts are those collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (*75-1-220, MCA*). The potential cumulative effects to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective anticipated direct and indirect impacts, other related existing actions, and future actions affecting the fish-bearing streams in the project area. In order to help convey a summary of potential cumulative impacts, a matrix of anticipated impacts to fisheries in the project area is displayed in *TABLE E-38 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF NO-ACTION ALTERNATIVE A* and *TABLE E-39 (THROUGH E-42) – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE B, (C, D, AND E)*.

TABLE E-38 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF NO-ACTION ALTERNATIVE A

	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Presence and genetics	None	None	None	None
Flow regimes	None	None	None	None
Sediment	None	None	None	None
Channel forms	None	None	None	None
Riparian function	None	None	None	None
Large woody debris	None	None	None	None
Stream temperature	None	None	None	None
Connectivity	None	None	None	None
Other related actions	Low	Low	None	Low
Future actions	None	Very low	Very low	None
Cumulative effects	Very low to low	Very low to low	Very low	Very low to low

TABLE E- 39 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE B

	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Presence and genetics	None	None	None	None
Flow regimes	Very Low	Low	Low	Very Low
Sediment	Low	Low	Moderate	Low
Channel forms	Low	Low	Low	Low
Riparian function	Low	Low	Low	Low
Large woody debris	Very Low	None	None	Very Low
Stream temperature	Low	Low	Low	Low
Connectivity	None	None	None	None
Other related actions	Low	Low	None	Low
Future actions	None	Very Low	Very Low	None
Cumulative effects	*Low*	*Low*	*Moderate*	*Low*

- ***Cumulative Effects of No-Action Alternative A to Fisheries***

In order to correctly interpret the potential for cumulative impacts in this fisheries analysis, the anticipated cumulative impact to a specific stream is relative to the existing conditions. For instance, there is likely a 'moderate' level of existing collective impacts to fisheries in South Fork Lost Creek (see *EXISTING CONDITIONS*). As a result of the selection of No-Action Alternative A, a potential 'very low to low' level of cumulative impacts that may occur in addition to the 'moderate' level of existing collective impacts to fisheries that currently exist.

Other related actions that are considered in the existing cumulative impacts are low impacts to South Fork Lost and Soup creeks due to existing adjacent road use by recreational vehicles, low impacts to South Fork Lost and Soup creeks due to recreational fishing, and low impacts to South Fork Lost and Cilly creeks due to historic riparian harvesting on other land ownerships in the project area.

No future actions have been identified for consideration in the South Fork Lost Creek and Soup Creek drainages.

Two future actions that have been identified for consideration in the Cilly Creek drainage are the Cilly Bug Salvage Timber Sale Project and Red Ridge Salvage Permit. The Cilly Bug Salvage Timber Sale Project is expected to include a riparian harvest through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 1,800 feet adjacent to the north side of the non-fish-bearing reach of Cilly Creek. The only fish habitat variable in the downstream fish-bearing reach of Cilly Creek that may be affected by the action is stream temperature. As a result of this action, potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are very low. The Red Ridge Salvage Permit proposes to harvest timber from approximately 30 acres in the Cilly Creek watershed. The proposed timber harvest would take place approximately 0.5 miles from Cilly Creek, and road use associated with the timber harvest is not expected to have any adverse impacts to Cilly Creek. As a result of this action, no potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are expected.

The Red Ridge Salvage Permit has been identified as a future action for consideration in the Unnamed Creek drainage. This permit proposes to harvest timber from approximately 60 acres in the Unnamed Creek watershed. The permit is expected to include riparian harvesting through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 700 feet adjacent to the northeast side of the fish-bearing reach of Unnamed Creek. Stream temperature is the only fish habitat variable in the downstream fish-bearing reach of Unnamed Creek that may be affected by the action. As a result of this action, the potential direct and indirect impacts to the stream temperature component of fish habitat in Unnamed Creek are very low.

The determination of cumulative impacts in this fisheries analysis is based on an assessment of all variables. As a result of these considerations, determinations of foreseeable cumulative impacts in this analysis are primarily a

consequence of other related actions and future actions.

As a result of the selection of No-Action Alternative A, cumulative impacts to fisheries in South Fork Lost, Cilly, Unnamed, and Soup creeks are expected to be very low to low beyond those impacts described in *EXISTING CONDITIONS*.

- ***Cumulative Effects of Action Alternative B on Fisheries***

In order to correctly interpret the potential for cumulative impacts in this analysis, the anticipated cumulative impact to a specific stream is relative to *EXISTING CONDITIONS*. For instance, the level of existing collective impacts to fisheries in South Fork Lost Creek is likely 'moderate' (see *EXISTING CONDITIONS*). As a result of the selection of Action Alternative B, a potential 'low' level of cumulative impacts may occur in addition to the 'moderate' level of existing collective effects to fisheries that currently exist.

Other related actions that are considered in the existing cumulative impacts are a low impact to South Fork Lost and Soup creeks due to existing adjacent road use by recreational vehicles, a low impact to South Fork Lost and Soup creeks due to recreational fishing, and a low impact to South Fork Lost and Cilly creeks due to historic riparian harvesting on other land ownerships in the project area.

No future actions have been identified for consideration in the South Fork Lost Creek and Soup Creek drainages.

Two future actions that have been identified for consideration in the Cilly Creek drainage are the Cilly Bug Salvage Timber Sale Project and Red Ridge Salvage Permit. The Cilly Bug Salvage Timber Sale Project is expected to include a riparian harvest through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 1,800 feet adjacent to the north side of the non-fish-bearing reach of Cilly Creek. The only fish habitat variable in the downstream fish-bearing reach of Cilly Creek that may be affected by the action is stream temperature. As a result of this action, potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are very low. The Red Ridge Salvage Permit proposes to harvest timber from approximately 30 acres in the Cilly Creek watershed. The proposed timber harvest would take place approximately 0.5 miles from Cilly Creek, and road use associated with the timber harvest is not expected to have any adverse impacts to Cilly Creek. As a result of this action, no potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are expected.

The Red Ridge Salvage Permit has been identified as a future action for consideration in the Unnamed Creek drainage. This permit proposes to harvest timber from approximately 60 acres in the Unnamed Creek watershed, and is expected to include riparian harvesting through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 700 feet adjacent to the northeast side of the fish-bearing reach of Unnamed Creek. Stream temperature is the only fish habitat variable in the downstream fish-bearing reach of Unnamed Creek that may be affected by the action. As a result of this action, potential direct and indirect impacts to the stream temperature component of fish habitat in Unnamed Creek are very low.

The determination of cumulative effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. Anticipated impacts from sedimentation and connectivity tend to have a greater level of risk to fisheries than the anticipated impacts from flow regimes and riparian function. As a result of these considerations, determinations of foreseeable cumulative impacts in this analysis are primarily a consequence of potential sedimentation from various sources, such as flow regime, potential riparian soil disturbance, and windthrown root wads.

As a result of the selection of Action Alternative B, an overall moderate risk of low cumulative impacts to fisheries is expected in South Fork Lost, Cilly, and Soup creeks beyond those impacts described in *EXISTING CONDITIONS*. An overall moderate risk of a moderate cumulative impact is expected to fisheries in Unnamed Creek. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative B.

- ***Cumulative Effects of Action Alternative C to Fisheries***

The assessment of potential cumulative effects follows the same methodology described in Action Alternative B. Other related future actions are also expected to be the same as those described in Action Alternative B. In order to help convey a summary of potential cumulative impacts as a result of implementing Action Alternative C, a matrix of anticipated effects to fisheries in the project area is displayed in *TABLE-40 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMUILATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE C*.

As a result of the selection of Action Alternative C, an overall moderate risk of low cumulative impacts to fisheries is expected in South Fork Lost, Cilly, and Soup creeks beyond those impacts described in *EXISTING CONDITIONS*. An overall moderate risk of a moderate cumulative impact is expected to fisheries in Unnamed Creek. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative C.

TABLE E-40 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE C

	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Presence and genetics	None	None	None	None
Flow regimes	Very low	Low	Low	Very low
Sediment	Low	Low	Moderate	Low
Channel forms	Low	Low	Low	Low
Riparian function	Very low	Low	Low	Very low
Large woody debris	None	Low	None	Very low
Stream temperature	Low	Low	Low	Low
Connectivity	None	None	None	None
Other related actions	Low	Low	None	Low
Future actions	None	Very low	Very low	None
Cumulative effects	*Low*	*Low*	*Moderate*	*Low*

- ***Cumulative Effects of Action Alternative D to Fisheries***

The assessment of potential cumulative effects follows the same methodology described in Action Alternative B. Other related future actions are also expected to be the same as those described in Action Alternative B. In order to help convey a summary of potential cumulative impacts as a result of implementing Action Alternative D, a matrix of anticipated effects to fisheries in the project area is displayed in *TABLE-41 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE D*.

As a result of the selection of Action Alternative D, an overall moderate risk of low cumulative impacts to fisheries is expected in South Fork Lost and Soup creeks beyond those impacts described in *EXISTING CONDITIONS*. An overall moderate risk of a moderate cumulative impact is expected to fisheries in Cilly and Unnamed creeks. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative D.

TABLE E-41 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE D

	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Presence and genetics	None	None	None	None
Flow regimes	Very low	Low	Low	Very low
Sediment	Low	Moderate	Moderate	Low
Channel forms	Low	Low	Low	Low
Riparian function	Low	Low	Low	Low
Large woody debris	Very low	None	None	Very low
Stream temperature	Low	Low	Low	Low
Connectivity	None	None	None	None
Other related actions	Low	Low	None	Low
Future actions	None	Very low	Very low	None
Cumulative effects	*Low*	*Moderate*	*Moderate*	*Low*

- ***Cumulative Effects of Action Alternative E to Fisheries***

The assessment of potential cumulative effects follows the same methodology described in Action Alternative B. Other related future actions are also expected to be the same as those described in Action Alternative B. In order to help convey a summary of potential cumulative impacts as a result of implementing Action Alternative E, a matrix of anticipated effects to fisheries in the project area is displayed in *TABLE-42 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE E*.

As a result of the selection of Action Alternative E, an overall moderate risk of a low cumulative impact to fisheries is expected in the South Fork Lost, Cilly, Unnamed, and Soup creeks beyond those impacts described in the *EXISTING CONDITIONS*. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative E.

TABLE E-42 – MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE E

	SOUTH FORK LOST CREEK	**CILLY CREEK**	**UNNAMED CREEK**	**SOUP CREEK**
Presence and genetics	None	None	None	None
Flow regimes	Very low	Low	Very low	Very low
Sediment	Low	Low	Low	Low
Channel forms	Low	Low	Low	Low
Riparian function	Very low	Low	Low	Low
Large woody debris	None	Low	None	Very low
Stream temperature	Low	Low	Low	Low
Connectivity	None	None	None	None
Other related actions	Low	Low	None	Low
Future actions	None	Very low	Very low	None
Cumulative effects	*Low*	*Low*	*Low*	*Low*

SPECIALIST RECOMMENDATIONS

- **POPULATIONS – PRESENCE AND GENETICS**

  No recommendations

- **HABITAT – FLOW REGIMES**

  No recommendations

- **HABITAT – SEDIMENT and CHANNEL FORMS**

  - Apply all applicable Forestry BMPs (including the SMZ Law and Rules) and Forest Management Administrative Rules for soils riparian management zones.
  - Monitor all road stream crossings for sedimentation and deterioration of road prism.
  - Only allow equipment traffic at road stream crossings when road prisms have adequate load-bearing capacity.

- **HABITAT – RIPARIAN FUNCTION, LARGE WOODY DEBRIS, AND STREAM TEMPERATURE**

  - Apply all applicable BMPs (including SMZ Law and Rules) and Forest Management Administrative Rules for fisheries riparian management zones to fish-bearing streams in the project area.
  - South Fork Lost Creek

    Immediately adjacent to proposed harvest units, establish the outside edge of the fisheries riparian management zone at 95 feet from the nearest bankfull edge of the stream channel. Within the fisheries riparian management zone, provide adequate large-woody-debris recruitment and stream shading by (1) creating a no-cut buffer from the nearest bankfull edge of the stream channel to 25 feet, and (2) harvesting a maximum of 50 percent of trees greater than 8 inches in diameter at breast height from 25 to 95 feet.
  - Cilly Creek

    Immediately adjacent to proposed harvest units, establish the outside edge of the fisheries riparian management zone at 91 feet from the nearest bankfull edge of the stream channel. Within the fisheries riparian management zone, provide adequate large-woody-debris recruitment and stream shading by implementing the SMZ Law and Rules for Class 1 streams.
  - Soup Creek

    Immediately adjacent to proposed harvest units, establish the outside edge of the fisheries riparian management zone at 83 feet from the nearest bankfull edge of the stream channel. Within the fisheries riparian management zone provide adequate large-woody-debris recruitment and stream shading by (1) creating a no-cut buffer from the nearest bankfull edge of the stream channel out to 25 feet and (2) harvesting a maximum of 50 percent of trees greater than 8 inches in diameter at breast height from 25 to 83 feet.
  - Apply the SMZ Law and Rules to all non-fish-bearing streams in the project area.

- **HABITAT – CONNECTIVITY**

  No recommendations

- **CUMULATIVE IMPACTS**

  No recommendations

SUMMARY OF ANTICIPATED PROJECT-LEVEL MONITORING IF AN ACTION ALTERNATIVE IS SELECTED

- Bull trout, and, in some cases, westslope cutthroat trout, population monitoring through annual redd counts.
- McNeil core and substrate score monitoring in bull trout spawning reaches in South Fork Lost and Soup creeks.
- Fish habitat monitoring, such as a repeat of R1/R4 surveying, in South Fork Lost and Soup creeks.
- Riparian stand characteristics (quadratic mean diameter, trees per acre, basal area) monitoring in proposed selective riparian-harvest areas adjacent to South Fork Lost and Soup creeks.
- Angular canopy density (shade) monitoring in South Fork Lost and Soup creeks adjacent to proposed selective riparian-harvest areas.
- Large-woody-debris frequency and volume monitoring in South Fork Lost and Soup creeks.
- Stream temperature monitoring in South Fork Lost, Cilly, and Soup creeks.

APPENDIX F
WILDLIFE ANALYSIS

INTRODUCTION

The discussion in this section pertains to wildlife species and their habitat in the existing environment and changes to that environment due to each alternative. If habitat does not exist in the project area or would not be modified by any alternative, species that use that habitat were dismissed from further analysis. Where species use of the area is probable, an analysis was performed. To conduct this analysis, a cumulative-effects analysis area was defined in which to assess the effects to the species in question. The Three Creeks Timber Sale Project area, South Fork Lost Soup Grizzly Bear Subunit, and Swan River State Forest scales were considered for possible analysis areas. The scale of analysis considered varied according to the species being discussed, but generally approximates the size of seasonal home ranges, total home ranges, or multiple home ranges representing a portion of the population for the species in question. Once an analysis area for cumulative effects was defined, the existing condition within the analysis boundaries was determined to set the baseline. The existing condition (baseline) incorporates the results of the past actions and natural processes within the analysis area.

To assess the effects of each alternative, the changes that would occur due to project activities are described within the area where they occur (i.e., within the harvest unit). These changes are the direct and indirect effects of the proposed activities. The cumulative effects analysis considers how these changes alter the existing condition (which includes past actions) and what that means to the species in question at the analysis-area scale. After these changes and the subsequent effects are displayed and discussed, other activities that are occurring or are planned in the foreseeable future within the cumulative-effects analysis area are added into the effects analysis. The combination of the effects of the current proposal overlaid on the existing condition, with the addition of concurrent and foreseeable future actions, sum to determine the cumulative effect to the species in question.

TABLE OF CONTENTS

Introduction F-1
Methods F-1
Coarse-Filter Analysis F-2
- Disturbance........................F-2
- Covertypes and Age Classes.........F-6
- Old-Growth-Associated Species......F-7
- Forested Connectivity..............F-8
- Patch Size.........................F-16
- Coarse Woody Debris................F-17
- Snag Structure.....................F-19

Fine-Filter Analysis F-26
- Threatened and Endangered Species..F-27
- Sensitive Species..................F-43
- Big Game...........................F-53

METHODS

To assess the existing condition on DNRC-managed lands and the surrounding landscape within each cumulative-effects analysis area, a variety of techniques were used. Field reconnaissance, scientific literature, data from the SLI and MNHP, aerial photography, consultations with other professionals, and professional judgment provided information for the following discussion and effects analysis. In the effects analysis, changes in the habitat quality and quantity from the existing conditions were evaluated and explained.

Specialized methodologies are discussed under the species in which they apply.

COARSE-FILTER ANALYSIS

DNRC recognizes that it is an impossible and unnecessary task to assess an affected environment or the effects of proposed actions on all wildlife species. We assume that if landscape patterns and processes similar to those that species adapted to are maintained, then the full complement of species will be maintained across the landscape (*DNRC 1996*). This "coarse filter" approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate "historic conditions" across a landscape. In the coarse-filter analysis, disturbance, covertype and age class, forest connectivity, and snags and coarse woody debris were analyzed.

DISTURBANCE

Issue

Timber harvesting and the associated road use would increase motorized disturbance in the analysis area, which could result in displacement of wildlife species from adjacent habitats. Displacement from important habitats could result in decreased ability for the animal to survive and reproduce in the analysis area.

Existing Condition

Motorized disturbances can affect how wildlife species use their environment. Some species, such as grizzly bears and elk, are particularly sensitive to the disturbance related to motorized access and tend to avoid areas some distance from the source of disturbance. Conversely, some species, such as Canada lynx, tolerate motorized disturbance and do not alter their use of adjacent habitats substantially (*Mowat et al. 2000*). Additionally, the response to motorized disturbance and the distance of displacement effects can vary among individuals within a species. Therefore, this analysis focuses on quantifying the area where disturbance occurs (roads and harvest units) to rank the potential displacement effects caused by disturbance expected under all action alternatives.

The area where disturbance from motorized use occurs is the road surface; however, the displacement effects caused by the disturbance can extend well away from the road surface. Motorized disturbances related to this project would occur on the road surface by vehicles traveling to and from harvest units and by mechanized equipment and personnel within the harvest units. To quantify the minimum amount of disturbance, the acreage of driving surface of forest roads (14 feet wide) and Highway 83 (40 feet wide) were used to develop a hierarchy of potential disturbance to wildlife in the area. The effects of this disturbance resulting in displacement would extend some distance from the point of disturbance, which would vary by the species in question.

The South Fork Lost Soup Subunit cumulative-effects analysis area consists of the project area and valley bottom. The project area lies on the slopes above the valley bottom and extends upslope toward the Swan divide. The project area contains 8.4 miles of open road covering 14.5 acres (0.1 percent of the project area) and 20.1 miles of restricted roads (gated) covering 34.7 acres (0.3 percent) (*TABLE F-1 - ACREAGE OF ROAD SURFACES [PERCENT OF AREA] AT THE PROJECT LEVEL AND IN THE ANALYSIS AREA*). Due to the lack of open roads in the area, the project area experiences limited motorized access. The restricted roads in the area support minor levels of motorized administrative use. In the valley bottom, Highway 83 runs north and south near the

western edge of the subunit, with 2 main open roads (Cilly Creek and Soup Creek roads) running east towards the mountains. Other open roads enter the project area from the north (South Fork Lost Creek Road) and south (Soup Goat Cut-Across Road). These roads stay near the valley bottom or, in the case of South Fork Lost Road, follow the creek up the drainage bottom. All other roads are restricted, but provide for motorized administrative access and public nonmotorized access. Highway 83 accounts for 4.8 miles, covering 23.3 acres (0.1 percent of the analysis area); open roads account for 22.2 miles, covering 37.7 acres (0.1 percent); and restricted roads (gated) account for 47.8 miles, covering 81.1 acres (0.3 percent) of the 74.8 miles of roads in the analysis area (*TABLE F-1 - ACREAGE OF ROAD SURFACES [PERCENT OF AREA] AT THE PROJECT LEVEL AND IN THE ANALYSIS AREA*).

Consistent high levels of motorized use occur on Highway 83. There appears to be a relatively consistent moderate level of motorized use along open roads, with spikes during different seasons (i.e. big game hunting season). The motorized use occurring consistently on these open roads is generally associated with recreational traffic (traffic associated with sightseeing or accessing a recreational area), public firewood harvesting, and administrative use. Motorized vehicles on restricted roads are limited to administrative use while the subunit is inactive and commercial use when the subunit is active.

Predicted Effects to Wildlife Species Due to Disturbance

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Disturbance***

  No additional disturbances along existing roads or within harvest units would occur; therefore, no additional displacement of wildlife species would be expected.

- ***Direct and Indirect Effects of Disturbance Resulting from Action Alternatives B, C, D, and E***

  The amount of area that receives motorized disturbance would increase under all alternatives. These increases would result from the use of existing and newly constructed roads along with motorized activities in the harvest units. The increased vehicle traffic associated with each alternative on the highway and open roads would likely contribute negligibly to the displacement effects already occurring. However, introducing motorized disturbance within the harvest units and newly constructed road, along with increasing motorized use on existing restricted roads, would likely add to the amount of area where displacement could occur.

  To quantify the scale of disturbance associated with each alternative, the acreage of harvest units and driving surface of restricted roads (14 feet wide) were summed to develop a hierarchy of potential disturbance to wildlife in the area. All action alternatives would be implemented during a 3-year period. If the project is not completed during this time period, harvesting activities could

TABLE F-1 - ACREAGE OF ROAD SURFACES (PERCENT OF AREA) AT THE PROJECT LEVEL AND IN THE ANALYSIS AREA

ROAD STATUS	PROJECT LEVEL	ANALYSIS AREA
Highway	0.0 (<0.1%)	23.3 (0.1%)
Open	14.5 (0.5%)	37.7 (0.1%)
Restricted - gated	34.7 (0.3%)	81.1 (0.3%)
Total roads	49.2 (0.5%)	142.1 (0.5%)

potentially extend past 2009; but activities, if extended, would only occur between November 16 and March 31. Any or all portions of the timber harvesting and road use could occur at any time. This analysis considers each alternative as a whole and does not try to predict the timing of any phase of implementation of the alternative. Since this project is likely to be split into 3 timber sales, the effects expected under any alternative would likely be spread over time and space in some fashion. According to this analysis, Action Alternative E would produce the greatest amount of area where short-term disturbance would occur, followed by Action Alternatives D, B, and C, respectively (*TABLE F-2 - ACREAGE OF DISTURBED AREA WITHIN HARVEST UNITS AND ASSOCIATED ROAD USE EXPECTED UNDER EACH ALTERNATIVE*). The displacement effects due to motorized disturbance may extend for some distance away from the source and may vary by species and individual animals. Therefore, the risk of increased motorized disturbances resulting in displacement of wildlife species from important habitats follows the same trend. These effects are expected to last for the duration of the project. After completion of the project, some displaced species could move back into the area. The speed at which recolonization occurs would vary by species.

- ***Cumulative Effects of No-Action Alternative A to Disturbance***

Wildlife species are not expected to change their use of the analysis areas.

- ***Cumulative Effects to Disturbance Common to Action Alternatives B, C, D, and E***

In the longer term, the new construction of permanent restricted roads under each action alternative would increase the ability for administrative

TABLE F-2 - ACREAGE OF DISTURBED AREA WITHIN HARVEST UNITS AND ASSOCIATED ROAD USE EXPECTED UNDER EACH ALTERNATIVE

DISTURBANCE AREA	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Harvest acres	0	1,883	1,795	1,970	1,998
(Percent of project area)		(17.7)	(16.9)	(18.5)	(18.8)
(Percent of analysis area)		(6.3)	(6.0)	(6.6)	(6.7)
Existing restricted road driving surface acres	0	39	36	35	45
(Percent of project area)		(0.4)	(0.3)	(0.3)	(0.4)
(Percent of analysis area)		(0.1)	(0.1)	(0.1)	(0.2)
New road construction of permanent restricted driving surface acres	0	23	22	27	15
(Percent of project area)		(0.2)	(0.2)	(0.3)	(0.1)
(Percent of analysis area)		(0.1)	(0.1)	(0.1)	(0.1)
New road construction of temporary driving surface acres	0	9	11	7	8
(Percent of project area)		(0.1)	(0.1)	(0.1)	(0.1)
(Percent of analysis area)		(0.0)	(<0.1)	(<0.1)	(<0.1)
Total combined acres affected	0	1,954	1,864	2,039	2,066
(Percent of project area)		(18.4)	(17.5)	(19.2)	(19.4)
(Percent of analysis area)		(6.5)	(6.2)	(6.8)	(6.9)

motorized and public nonmotorized access. Of these alternatives, Action Alternative D would result in the greatest potential for additional disturbance over the long term due to the greatest increase in permanent road construction. Action Alternative E would require the least amount of permanent restricted road and, thereby, would result in the least risk of disturbance over the long term. Since administrative use is generally light and sporadic, the risk of additional or continued displacement is low. Since nonmotorized use generally results in fewer disturbances than motorized use and any increase in nonmotorized use is expected to be sporadic and not result in large changes over the existing condition, any additional risk to displacement due to the construction of new restricted roads is likely to be low under any action alternative.

The construction of new roads could also increase snowmobile access, resulting in increased disturbance during the winter period. However, since most proposed roads extend existing roads, are in current roaded areas, and end at harvest units, they likely would not greatly increase disturbance in the area. Under Action Alternatives D and E, a 3.5-mile road segment would extend into a previously unroaded area. In this case, the road provides access into new areas, resulting in increased winter disturbance to an area that is currently relatively inaccessible. Therefore, snowmobile disturbance is expected to be higher under Action Alternative D, followed by Action Alternative E, B, and C, respectively.

In addition to the potential disturbance caused by each action alternative, DNRC is concurrently considering 2 salvage harvests that total 120 acres and use 5 acres of existing restricted road surface in 2 locations within the analysis area. These harvests could add approximately 125 acres (0.4 percent of the analysis area) to the amount of habitat affected if these projects ran concurrently with the Three Creeks Timber Sale Project. The duration for the use of these roads and harvesting is expected to be less than 30 days. Therefore, the cumulative effects to any alternative would likely result in short-term negligible increases in displacement (*TABLE F-3 - CUMULATIVE AMOUNT OF ACRES WITHIN THE ANALYSIS AREA EXPECTED TO BE DISTURBED UNDER EACH ALTERNATIVE*).

TABLE F-3 - CUMULATIVE AMOUNT OF ACRES WITHIN THE ANALYSIS AREA EXPECTED TO

DISTURBANCE AREA	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Existing acres of all roads (Percent of analysis area)	142 (0.5)	142 (0.5)	142 (0.5)	142 (0.5)	142 (0.5)
Total affected acreage by alternative in the analysis area (Percent of analysis area)	142 (0.5)	2,096 (7.0)	2,006 (6.7)	2,181 (7.3)	2,208 (7.4)
Additional projects (acres) (Percent of analysis area)	125 (0.4)	125 (0.4)	125 (0.4)	125 (0.4)	125 (0.4)
Total cumulatively affected acreage in the analysis area (Percent of analysis area)	267 (0.9)	2,221 (7.4)	2,131 (7.1)	2,306 (7.7)	2,333 (7.8)

COVERTYPES AND AGE CLASSES

Issue

Timber harvesting and natural processes can alter the distribution of covertypes and age classes found on the landscape. Changes from historic conditions could result in adverse effects to native wildlife species.

Existing Condition

Covertype and age class proportions provide a variety of habitats for wildlife species. It is assumed that the closer the proportions and distributions of covertypes and age classes mirror the "historic levels" reported by *Losensky (1997)*, the more likely DNRC-managed lands are providing adequate levels of habitat for native species (see *APPENDIX C – VEGETATION ANALYSIS*). Based on the vegetation analysis conducted on the SLI data, mixed-conifer covertypes are overrepresented, while western larch/Douglas-fir and western white pine are underrepresented when compared to historic levels. When averaged over all covertypes, stands on Swan River State Forest tend to be older than expected. These conditions likely lead to increased habitat for species that use older, denser stands, which include a variety of tree species at the expense of species that use more-open stands dominated by shade-intolerant tree species.

Predicted Effects to Wildlife Species Due to Changes in Covertypes and Age Classes

- ***Direct and Indirect Effects of No-Action Alternative A to Covertypes and Age Classes***

  No changes in covertypes or age classes are expected in the short term. Over time, trees would continue to age and shade-intolerant trees would continue to die and be replaced by shade-tolerant species. These conditions would lead to an increasing deviation from historic distributions of covertypes and age classes. These changes would continue and increase the risk of not providing adequate levels of habitat for native species.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E to Covertypes and Age Classes***

  Under all action alternatives, a portion of the harvested stands would be converted from mixed-conifer covertypes to shade-intolerant covertypes (western larch/Douglas-fir and western white pine) and also reduce the average age of stands. These changes in covertypes and the conversion of older stands to younger stands move the stand proportions toward historic conditions; however, historic age distributions may not necessarily be retained within those covertypes. Specifically, the conversion of older western larch/ Douglas-fir and ponderosa pine stands into younger stand classes causes movement away from historic age class proportions in these covertypes (see *APPENDIX C – VEGETATION ANALYSIS*). Reductions of older-aged stands in other covertypes move Swan River State Forest more toward historic conditions of age class within the covertypes affected. The changes proposed are expected to result in beneficial effects for species that use shade-intolerant covertypes; however, these benefits may be delayed due to the conversion of older-aged stands to younger-aged, shade-intolerant stands. In the short-term, species that use older, denser stands with a variety of tree species would be negatively impacted; however, these species would likely still have at least as much, if not more, habitat available than would be expected under historic conditions. Action Alternative C would result in a higher rate of conversion from mixed-conifer to western larch/ Douglas-fir covertypes, while

retaining a higher proportion of older-aged stands, followed by Action Alternatives D, B, and E, respectively. Action Alternatives C, D, and E would enter approximately 18 acres of ponderosa pine old stands and reduce the age class to a 100-year-old stand.

- ***Cumulative Effects of All Alternatives to Covertypes and Age Classes***

  The cumulative effects of recent forest-management activities on Swan River State Forest result in a trend of increasing seral covertypes and the amount of younger age classes across areas where management has occurred. These trends generally tend toward historic proportions; therefore, native species are generally benefiting from the changes in covertype and age-class distributions. However, these benefits may be delayed due to the conversion of older-aged stands to younger-aged, shade-intolerant stands.

OLD-GROWTH-ASSOCIATED SPECIES

Issue

Old growth provides habitat components for a host of wildlife species. Decreasing amounts of habitat available to less than the amounts expected historically could adversely affect species that use old-growth habitats to fulfill their life requirements.

Existing Condition

Many wildlife species use old-growth habitats. *Warren (1998)* indicates that approximately 31 wildlife species are associated with old-growth forests on the FNF. *APPENDIX C – VEGETATION ANALYSIS* indicates that the current acreage of old growth on Swan River State Forest is less than the acres estimated in the 1930s inventory, but greater than would be expected as a long-term average for the climatic section (*Losensky 1997*).

Although the percentage of the area occupied by old growth, overall, on Swan River State Forest is presently greater than what would have been expected with long-term average conditions, function may be compromised for some species due to reductions of old growth in some covertypes and overall reductions in average patch size, patch shape, and loss of connectivity. The current distribution, covertypes, and attribute levels are displayed in *APPENDIX C - VEGETATION ANALYSIS*.

Based on the vegetation analysis of Swan River State Forest, overabundances of old growth occur in the Douglas-fir, western white pine, mixed-conifer (includes stands dominated by western red cedar), and subalpine fir covertypes, while shortages occur in ponderosa pine, western larch/Douglas-fir, and lodgepole pine covertypes. These differences are attributable to the differential selection of covertypes that were harvested, covertype conversions due to fire exclusion and forest succession, and a minor degree of classification and sampling error. Wildlife species typically associated with old growth in the covertypes that are overrepresented presumably benefited from additional habitat, while those associated with underrepresented types likely suffered from lower amounts of available habitat.

Predicted Effects to Old-Growth-Associated Species

Direct and Indirect Effects

- ***Direct and Indirect Effects of the No-Action Alternative A to Old-Growth-Associated Species***

  No harvesting of timber would take place; therefore, no changes in the amount or quality of old-growth habitats would occur.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E to Old-Growth-Associated Species***

  Some amount of stand-replacement-type harvesting of old growth would occur under each action alternative. Thus, young age classes of stands would likely develop for several years following treatments. In some harvest units, the number of large trees retained could meet the minimum criteria for old-growth; however, these stands may not necessarily meet the needs of old-growth-associated species, especially those species that prefer densely forested climax stands. Where old-growth habitat is altered, old-growth-associated species are expected to lose habitat.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Old-Growth--Associated Species***

  Following harvesting, all action alternatives retain proportions of old growth within Swan River State Forest that fall within the estimated range of historical amounts of old growth (15 to 52 percent). Therefore, the overall risk of adverse effects to species that use these habitats is low because levels of old-growth habitats fall within the historic range expected on Swan River State Forest (see *APPENDIX C – VEGETATION ANALYSIS*). However, local reductions in old-growth habitats are expected to reduce habitat availability for species that use these habitats. The risk of affecting old-growth-associated species is greater under Action Alternative D than under Action Alternatives C, B, and E, respectively, due to the amount of old-growth harvested.

  No other harvests in old-growth stands are concurrently being considered or planned in the foreseeable future. Past activities that affected old growth were considered in the existing conditions. Therefore, no additional cumulative changes in the amount of old-growth stands are expected.

FORESTED CONNECTIVITY

Issue

Timber harvesting would remove forested cover that could result in the reduced ability of some wildlife species to move through their home range. Disruption of these regular daily, seasonal, and dispersal movements could result in a reduced ability of wildlife species to use and successfully reproduce in the area.

Existing Condition

Movement corridors that maintain connectivity between habitat patches function to allow regular daily and seasonal movements along with providing dispersal routes for juvenile animals (*Dobson et al. 1999*). These movements are important for species to successfully move between security cover (i.e. denning sites, bedding areas, etc.) and foraging sites to meet their life requirements. Additionally, movement corridors are important to allow for dispersing individuals to immigrate or emigrate from one population to the next to allow for genetic diversity.

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross broad, nonforested expanses. In general, wider, unfragmented, riparian, and diverse corridors provide the most effective connectivity (*Fischer and Fischenich 2000*). The width of the travel corridor tends to determine the efficacy of the corridor for individual species. In general, a wider corridor would be more effective and provide for more species than a narrower one. Narrower corridors provide some level of connectivity, especially

for smaller species, such as rodents. However, these narrow corridors could also serve as funnels that increase predator efficiency and reduce survival of the individual prey species that are using the corridor (*Groom et al. 1999*). Seedling and sapling stands can also provide connectivity cover for some species such as snowshoe hares (*Ausband 2004*), but may not provide connectivity for species that prefer environments with dense mature forest canopy.

Based on *ARM 36.11.403(20)(b)*, corridors of 300 feet or greater are assumed to allow adequate connectivity to the larger mammals that inhabit the project area, such as fishers (*Jones 1991*) and lynx (*Koehler 1990*). To assess connectivity, pole and sawtimber-sized stands semi-closed (40- to 70-percent canopy closure) and closed canopy (greater than 70-percent canopy closure) and greater than 300 feet wide were considered to provide travel cover for species expected to benefit from interconnected forest stands.

The South Fork Lost Soup Subunit cumulative-effects analysis area consists of valley bottom and mountainous terrain. The project area lies on the slopes between the valley bottom and the upper elevations of the subunit. Generally, high levels of forest connectivity exist in the mountainous area, with many scattered openings existing on the valley floor portions of the analysis area. Forest connectivity is mostly maintained throughout the analysis area along the ridges, along 4 major streams running from the mountains and draining into the Swan River, and across third-order drainages (South Fork Lost and Soup creeks). Several breaks where forest cover is reduced to less than 300 feet across the stream occur along these creeks (*FIGURE F-1 - EXISTING FOREST COVER, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*). These openings are natural openings (wet meadows, shrub fields, avalanche chutes) or old harvest units. In most cases, these openings contain at least some horizontal cover from shrubs or regenerating trees, thereby providing some cover within the opening. Additionally, these areas are generally small (*FIGURE F-1)*. These conditions provide a well-connected forest environment for animals to move relatively unimpeded through the cumulative-effects analysis area. However, in the valley bottom, several open roads, including Highway 83, present human-caused impediments to connectivity.

Predicted Effects to Wildlife Due to Changes in Connectivity

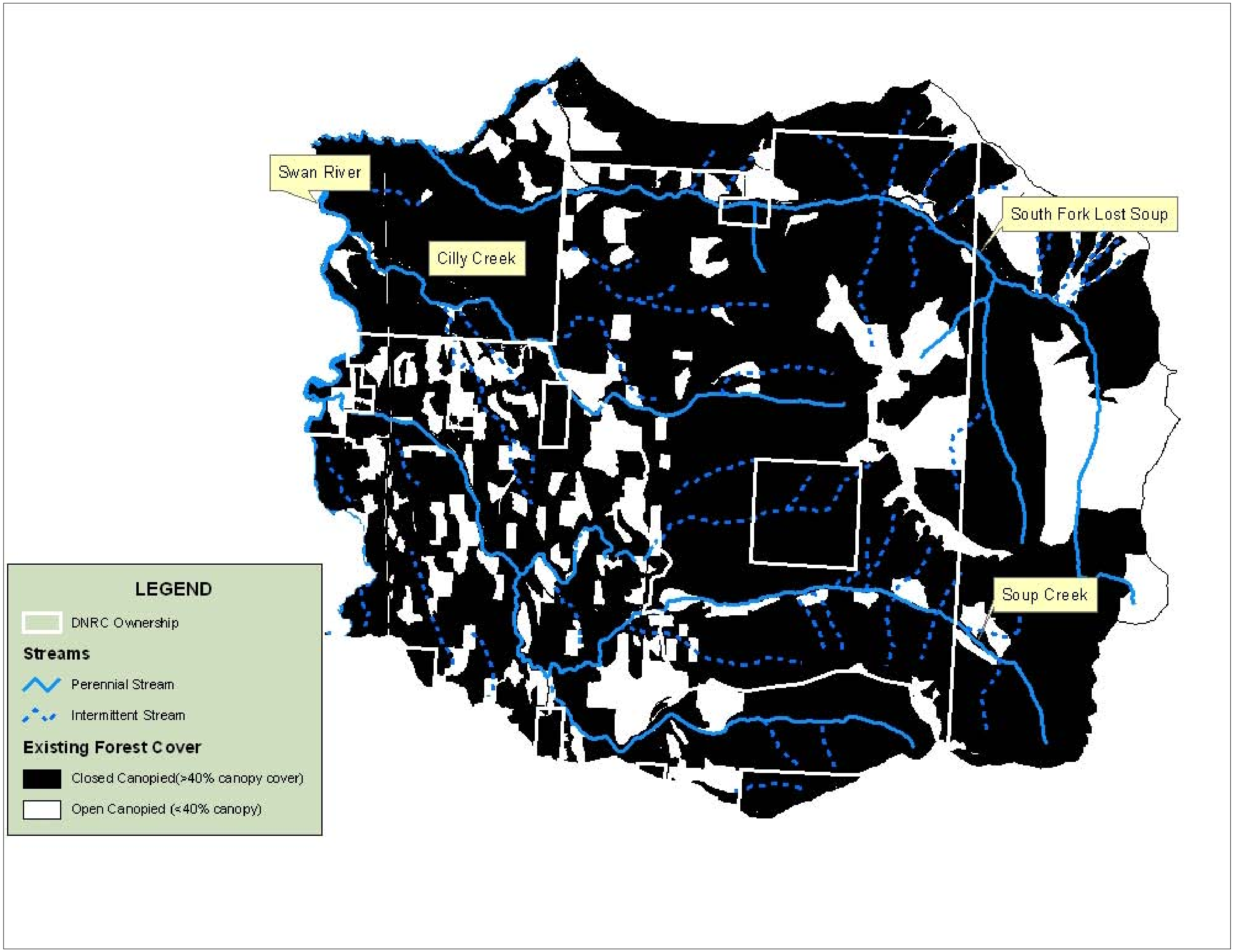
- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Connectivity***

  No short-term changes in forest connectivity are expected. Over time and in the absence of natural disturbance, forest connectivity would be expected to increase due to the successional conversion of early seral stands and sparse stands to older stands providing overhead forest cover. The increase in connectivity would benefit species that depend on dense interconnected forests by providing movement corridors between habitats within the project area.

- ***Direct and Indirect Effects Common of Action Alternatives B, C, D, and E to Connectivity***

  Each action alterative could alter connectivity of mature forest patches by creating gaps and producing large openings in the uplands (refer to *PATCH SIZE in this analysis*). However, the project design for each alternative includes mitigations to maintain forest connectivity along the 4 major streams (Soup, Cilly, Unnamed, and South Fork Lost creeks) in the project area. Where seedtree or shelterwood

FIGURE F-1 - EXISTING FOREST COVER, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA



prescriptions occur on both sides of a major stream, a 150-foot buffer on either side of the stream (300-foot width, total) would be retained. If harvesting occurs on only 1 side of the stream and ample forest cover is provided on the opposite side of the stream, a 100-foot buffer from the stream would be retained along the harvested portion. Along the 4 main streams, no timber-harvesting activities would occur within 25 feet of the stream. From 25 feet to the buffer width, up to half of the trees 8 inches dbh or greater could be harvested, but an average of 40 percent or greater canopy cover would be required to be retained. In these buffers, small openings of 0.25 acre or less could occur in cable-yarding corridors or in skid trails.

Forest connectivity through the project area would be retained in unharvested stands along the ridges (south of South Fork Lost, Cilly, and Soup creeks), across third-order drainages (Soup and South Fork Lost creeks), and along streams with the buffers described above (*FIGURE F-2 (3, 4, 5) - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE B (C, D, and E), WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*). With these mitigations in place, a minimum of 300-foot-wide corridors would be retained along all major creeks that run through the harvest units. Connectivity on upland sites would be reduced under each alternative, but in areas used by wildlife species for travel (ridges and streams), adequate forest cover would remain. Therefore, all alternatives would result in minor risk to preventing movement through the project area.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Connectivity***

Other activities that could affect forested connectivity in the analysis area include: open roads, DNRC salvage harvests, potential timber harvests on adjacent lands, and tree mortality due to insects and diseases.

The highway (4.8 miles) and open roads (22.2 miles) currently in the analysis area would continue to decrease habitat connectivity to some unknown level. All action alternatives under this project result in an additional 0.4 miles of open road. The new road would result from rerouting South Fork Lost Creek Road away from the creek. Although a slight increase in the length of open roads would occur from moving the road out of the South Fork Lost Creek riparian area, connectivity could improve by reducing the disturbance in the riparian corridor. This action would enhance forested connectivity along the 1.3 miles of stream where disturbance would be reduced.

In addition to this project, DNRC is proposing to harvest 120 acres in 2 projects, while no other harvests on other ownerships are planned for the 3-year active period. The DNRC salvage harvests would occur on the valley floor, but away from streams. Additionally, the harvests would not likely reduce the canopy closure to less than 40 percent. Therefore, wildlife species could still move through the area, resulting in negligible additional reductions in connectivity.

Insect and disease activity continues to kill trees in the analysis area. These agents tend to kill the larger trees, leaving the smaller trees in the understory. As the larger overstory trees die, the younger trees grow and fill in the gap left by the dead overstory trees.

FIGURE F-2 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE B, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA

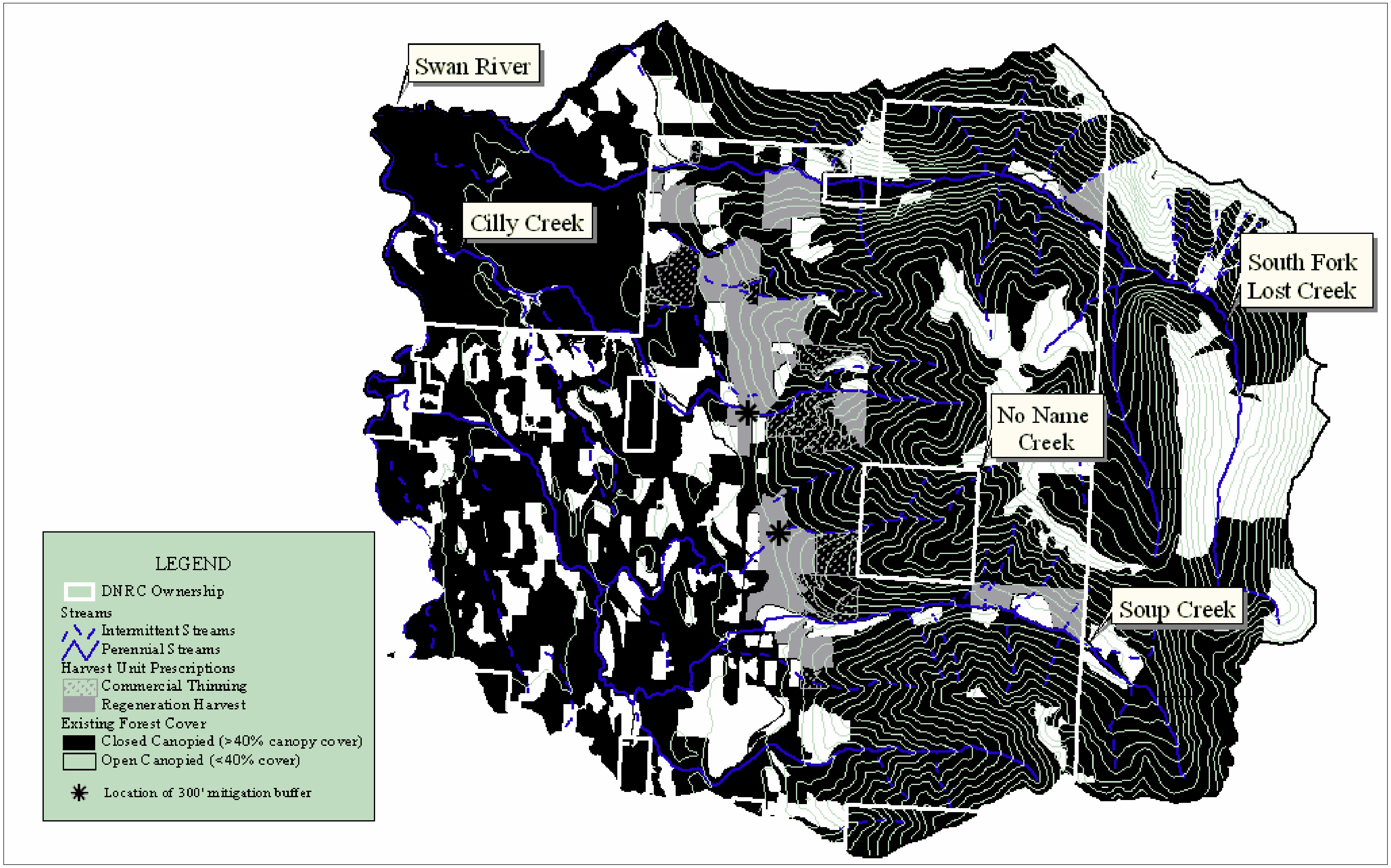


FIGURE F-3 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE C, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA

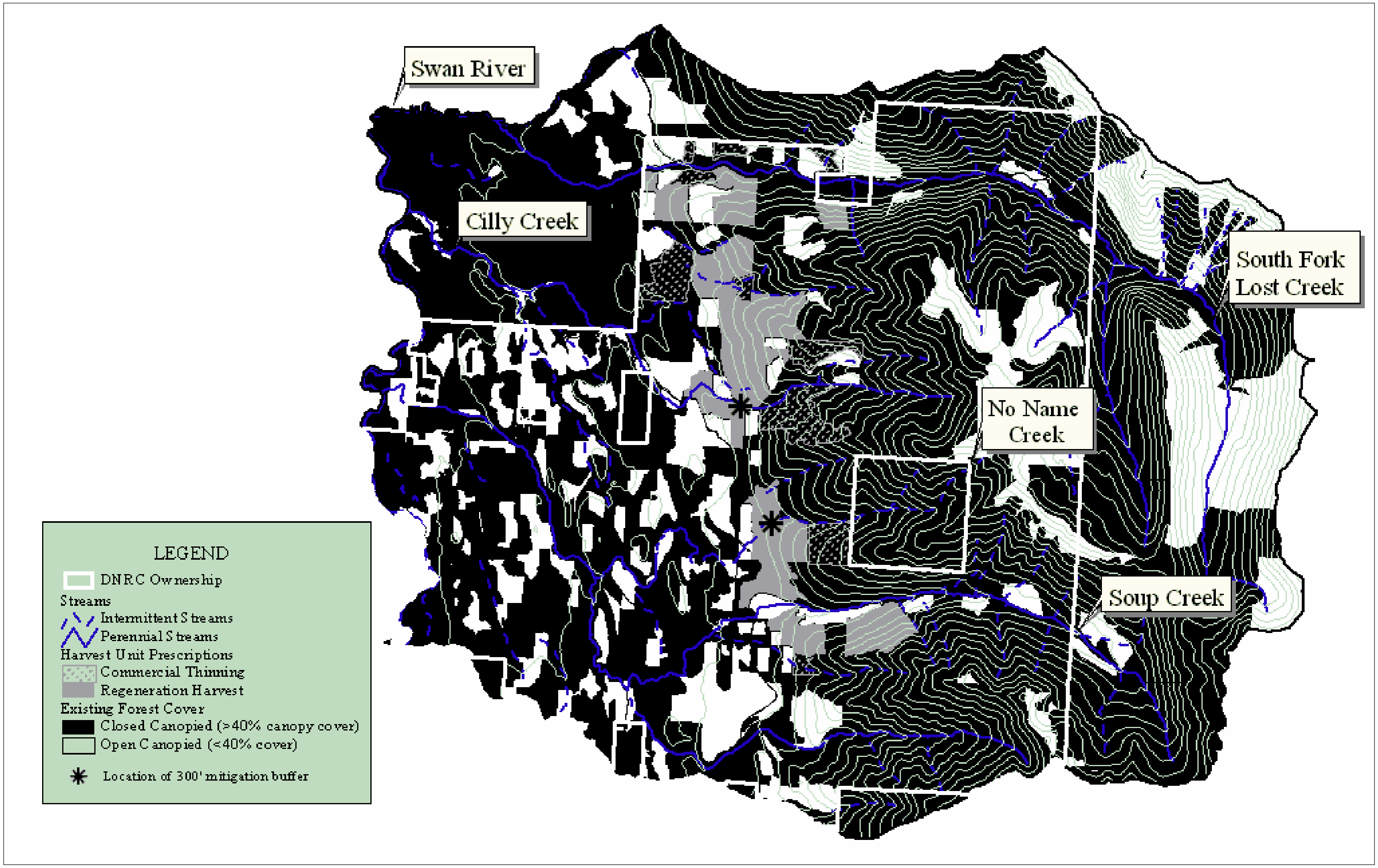
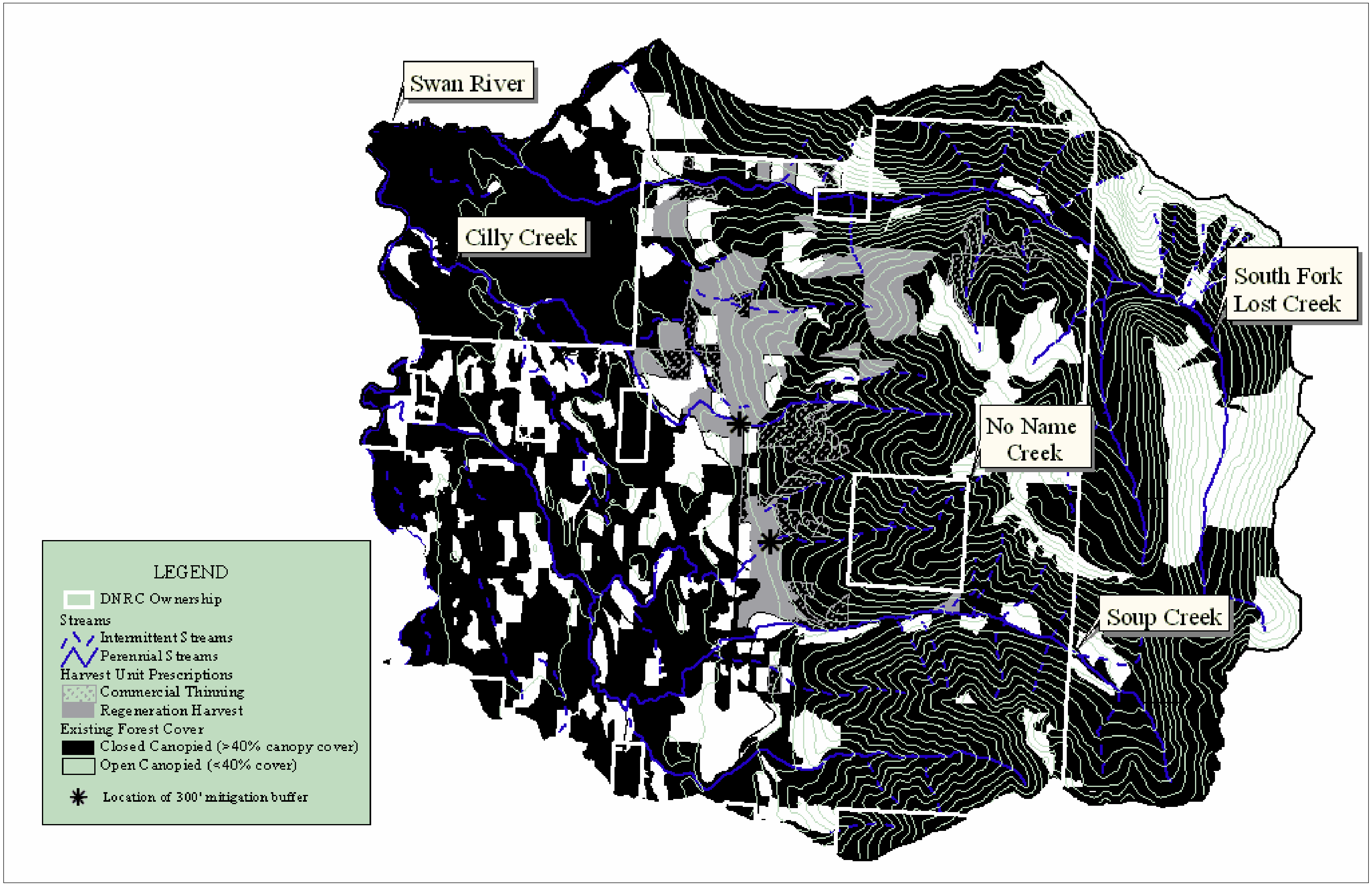


FIGURE F-4 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE D, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA

FIGURE F-5 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE E, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS



In most cases, this situation results in retaining forested cover. In some cases, patches of trees are killed, leaving open forested cover. If these patches attain a large size, forest connectivity could be reduced. In the analysis area, the effects of insects and diseases tend to shift the proportions of tree species in stands, but retain 40-percent canopy closure, or at least horizontal cover, in the stand. Therefore, only small, short-term additional reductions to forest connectivity due to insects and diseases are expected.

Considered in conjunction with other past, present, and future activities, any action alternatives would likely result in minor cumulative effects to connectivity.

PATCH SIZE

Issue

Timber harvesting could reduce the average patch size of age classes. These changes could reduce habitat available for species that require a large patch size or interior habitats.

Existing Condition

Species that are hesitant to cross broad expanses without forest cover, or those that depend upon interior forest conditions, can be sensitive to the amount and spatial configuration of appropriate habitat. Therefore, patch size, patch juxtaposition, and connectivity of forest patches can influence habitat quality and population dynamics for some species. Some species are adapted to thrive near patch edges, while others are adversely affected by the presence of edge, or by the presence of other animals that prosper in edge habitats. Therefore, this analysis considers the effects of patch size of age classes of forest stands (discussed in *APPENDIX C – VEGETATION ANALYSIS*) on wildlife species.

The current patch size in the project area and within Swan River State Forest deviates from historic conditions (refer to *APPENDIX C – VEGETATION ANALYSIS*). Presently, the average patch size is smaller than would be expected under historic conditions. Some of the decrease can be attributed to different map-unit minimums, but the data likely reflects a real reduction in mean patch sizes, as harvesting and roads have broken up some previously intact patches. These conditions probably lead to an increase in habitat for species that use a diversity of age classes or edge habitats at the expense of habitat for species that use interior habitats.

Predicted Effects to Patch Size

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Wildlife Species Due to Changes in Patch Size***

  Patch size and configuration would not change in the short-term within the project area or cumulative-effects analysis area (Swan River State Forest). In the longer term, without substantial natural disturbance, patch size is expected to increase in the older age-class categories, while diversity of habitats and edge habitats would decrease. Since the current mean patch size is smaller than expected under historic conditions, this alternative would allow movement toward historic conditions. Species that use large blocks of closed-canopy forested habitats would be impacted the least by this alternative.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E to Wildlife Species Due to Changes in Patch Size***

  All action alternatives would reduce patch size of old-aged stands and increase patch size of the 0-to-39-year-old stands within

the project area. All action alternatives reduce the average patch size of old stands by 50 to 55 percent. Action Alternatives B, E, C, and D, respectively, would result in the highest to lowest conversion of old stands to young stands. Conversely, all of the action alternatives propose harvests units to combine with current younger stands, resulting in increasing patch sizes of the 0-to-39-year-old age class. The results of all alternatives reduce the average patch size of old-aged stands further away from historic conditions, while increasing patch size in the 0-to-39-year-old age class over the historic average. Therefore, all alternatives trend away from historic patch size of old stands, resulting in a moderate risk of adverse impacts to species that use large patches of old-aged stands, while reducing the risk of adverse effects to species that use large patch sizes in the 0-to-39-year-old age class.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Wildlife Species Due to Changes in Patch Size***

The effects discussed above are expected to also occur at the Swan River State Forest analysis scale. The current salvage operations would not alter the age class or patch size within the cumulative-effects analysis area. Ongoing and completed projects (360 acres) would add to the conversion of older stands to younger stands, resulting in a smaller mean patch size of older stands and a larger mean patch size in the younger age class. Over time, these larger patches of younger stands would undergo successional processes to add to the patch size of the older age classes.

COARSE WOODY DEBRIS

Issue

Coarse woody debris provides important habitat attributes for a variety of wildlife species. Timber harvests could reduce coarse woody debris, leading to a decline in wildlife habitat quality. These declines could result in decreased survival or reproduction of species that require these attributes to fulfill their life or reproduction requirements.

Existing Condition

The presence of wildlife species contributes to healthy, functioning forests. Coarse woody debris provides structural diversity and promotes biological diversity by providing habitat for wildlife species. Many small mammals require coarse woody debris to survive. In turn, these species distribute ectomycorrhizal fungi, which is beneficial for seedling establishment and tree growth (*Amaranthus 1998, Graham et al. 1994*). The quality and distribution of coarse woody debris can affect habitat quality for these species. Higher quality habitat tends to be provided when coarse woody debris exists in longer lengths of large diameter logs than smaller and/or shorter logs. Single scattered logs provide lookout and travel sites for squirrels or access under the snow for small mammals and pine martens, while log piles provide habitat for weasels, hares, and other small mammals. Under natural conditions, logs tend to occur in patches across the landscape, with the occasional lone log.

To assess changes in coarse-woody-debris habitat components, the project area was used for the cumulative effects analysis area, since many animals that rely on coarse woody debris tend to have small home ranges (rodents, small woodpeckers, etc.). The project area is expected to encompass many home ranges of these species. Other

species that use coarse woody debris and have larger home ranges are analyzed under the fine-filter analysis. Presently, the project area (cumulative effects analysis area) contains many stands with moderate to high levels of coarse woody debris (see *APPENDIX C – VEGETATION ANALYSIS*). Within the analysis area, past harvests have been limited, thereby allowing increases in coarse woody debris. With the high incidence of insect and disease activities (see *APPENDIX C – VEGETATION ANALYSIS*), these levels could continue to increase. High amounts of coarse woody debris provide habitat for a variety of wildlife species, which have likely gained habitat structure over time as stands age.

Predicted Effects to Wildlife Species Due to Changes in Coarse Woody Debris

- ***Direct, Indirect, and Cumulative Effects of the No-Action Alternative A to Coarse Woody Debris***

  No changes in amount, type, or distribution of coarse woody debris are expected. Over time, coarse woody debris would increase in most stands due to trees dying and eventually falling to the ground. Under this alternative, species that use coarse woody debris would gain additional habitat, which would represent a low to moderate benefit to these species.

- ***Direct and Indirect Effect of Action Alternatives B, C, D, and E to Coarse Woody Debris***

  Coarse woody debris would be retained at 15 to 20 tons per acre within the harvest units (see *APPENDIX C – VEGETATION ANALYSIS*). In some cases, coarse woody debris could increase through harvesting; however, most of this material would be made up from pieces of cull boles, limbs, and tops. Few intact trees would be retained. Where broadcast burns are used for site preparation following harvesting, coarse woody debris could be further reduced. These reductions would occur mostly in the smaller-sized logs. The coarse woody debris following harvesting would provide some wildlife habitat; however, species that use large pieces of coarse woody debris could likely lose a portion of their habitat components within the harvest units.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Coarse Woody Debris***

  No additional effects to those listed above are expected, because no other activities are planned within the cumulative-effects analysis area. Losses to firewood gathering are expected to continue, especially near open roads. Away from open roads, coarse-woody-debris recruitment is expected to continue. Coarse woody debris could increase in the harvest units, while current levels are expected to be retained in adjacent stands. The levels of coarse woody debris in adjacent stands are expected to continue to provide habitat structure for species associated with coarse woody debris. The current levels of coarse woody debris in adjacent stands could mostly offset the changes expected within the harvests units. Additionally, the trees and snags retained in both harvested and unharvested stands would continue to provide a source of coarse-woody-debris recruitment over time. When past, present, and future actions were considered, a low risk that was projected by the changes in coarse woody debris under each alternative could result in substantial decreases in survival or reproduction of species that require these attributes to fulfill their life requirements. However, the risk level is higher in Action Alternative E, than in

Action Alternatives D, B, and C, respectively.

SNAG STRUCTURE

Issue

Snags provide important habitat attributes for a variety of wildlife species. Timber harvests could reduce the density of snags, leading to a decline in the quality of wildlife habitat. These declines could result in decreased survival or reproduction of species that require these attributes to fulfill their life or reproduction requirements.

Existing Condition

Snags play an important role in forested ecosystems by providing feeding and nesting sites for birds and mammals. Snags provide foraging sites for primary cavity-nesting species, along with structural components to excavate nesting sites. The cavities excavated by primary cavity-nesting species (woodpeckers) also provide habitat for secondary cavity users. These secondary cavity users include both birds and mammals. Additionally, these secondary cavity users could also take advantage of cavities produced by broken tops and fallen limbs. Without trees and snags that provide for cavities or substrate for cavity excavation, primary and secondary cavity species would not be able to survive and/or reproduce in the area.

The presence of some forest-dwelling birds is important to forest management. Several studies suggest that bird species diversity and population levels correlate with snag diversity and density (*McClelland 1979*). Birds provide many functions in forest ecosystems, from the dispersion of seeds to biological control of many forests insects that are harmful to wood production by predation, habitat modification (bark flaking), and providing avenues for disease transmission that reduce survival (*Ovtos 1979, Steeger et al. 1998*). Maintenance of insectivorous bird populations over time delays the onset of insect outbreaks, accelerates the decline following an outbreak, and increases the time span between outbreaks (*Otvos 1979, Torgenson 1994*). In 27 studies reviewed by *Steeger et al (1998)*, 26 concluded that insectivorous birds substantially reduced bark beetle survival. Estimates from these studies indicated a reduction in insect populations from 2 to 98 percent. *Koplin (1972)* estimated that a single three-toed woodpecker could consume several thousand beetle larvae per day. In addition to predation, some studies indicate that woodpeckers can contribute to bark beetle mortality indirectly by bark flaking, excavating, puncturing, etc., the bark of infected trees, thereby increasing parasite access to beetle brood (*Otvos 1965*) and altering the microclimate needed for survival (*Otvos 1979*). In areas with high densities of insects, woodpecker abundance can increase up to 7-fold during the breeding season and 85-fold during the winter. Downy, hairy, three-toed, and black-backed woodpeckers tend to be more apt than other species to congregate in these areas (*Steeger et al. 1998*). Some increased reproduction in response to insect outbreaks could occur, however, when a time lag between insect populations and the numerical response of their predators may take place. During time lags, the chance of insect epidemics may be greater. The ability of these species to congregate and reduce prey in such areas is dependent on maintenance of populations over time and retention of suitable habitat in the affected area (*Otvos 1979*).

The tree species, diameter, height, decay stage, and densities of snags determine the snag-habitat value for wildlife species. Larger, taller snags tend to provide nesting sites, while shorter snags and stumps tend to provide feeding sites for birds

(*Bull et al. 1997*). Cavity-nesting birds often nest in areas where several snags are available, using individual snags as feeding or roosting sites; therefore, considering the size and distribution of these resources is important. Many birds that use smaller snags will also use large snags; however, the opposite is not true.

To assess effects to primary and secondary cavity-nesting species, the project area was used for the cumulative-effects analysis area. The project area incorporates 10,636 acres of DNRC-managed lands, which could provide numerous breeding ranges for cavity-nesting species. The past management in this area is reflected by the existing condition. For the most part, the analysis area has been relatively unaffected by timber harvests in the recent past. Several open and restricted roads allow access into the analysis area. Public firewood cutting has taken place primarily in areas adjacent to these open roads, while DNRC-initiated salvage harvests used both open and restricted roads to access dead and dying trees. These harvests primarily removed Douglas-fir and grand fir snags, with some diseased western white pine and western larch snags also harvested. Due to the age of the stands and the presence of insects and diseases, snag development continues to occur.

To estimate an historic level of snag densities for the analysis area, the mean snag densities reported (snags/acre) from uncut stands in *Harris (1999)* were used. *Harris (1999)* looked at *Forest Inventory and Analysis* plot data from around western Montana in an attempt to estimate the abundance of snags in the absence of timber harvests. He calculated mean snag densities based on habitat-type group (*Green et al. 1992, Pfister et al. 1977*). It is important to note that the averages based on habitat-type group occurred throughout western Montana, not just within the analysis area or Swan Valley. In this analysis, no attempt was made to modify the plot means to account for other sources of biases (fire suppression). Therefore, the historic estimates are likely overestimated (*Harris 1999*). However, these are the best data available to estimate historic snag abundance in the analysis area.

To calculate an estimated average historic snag density for the analysis area, the area was divided into habitat-type groups using SLI data. For each habitat-type group, only those acres with stands older than 40 years were assumed to have snags for this analysis. For each habitat-type group, all acres of stands greater than 40 years old were multiplied by the corresponding mean snag density for uncut stands reported in *Harris (1999)*. This calculation produced a weighted average to estimate the mean density of snags in the analysis area. The result of this analysis estimated that the cumulative-effects analysis area contains 0.89 large snags per acre and 2.73 medium snags per acre, on average (*TABLE F-4 - ESTIMATED HISTORICAL SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING HARRIS [1999]*).

To understand how the existing condition relates to the estimated historic condition, snag estimates in the SLI dataset were used. The acres of stands older than 40 years in the analysis area were summed by habitat-type group. Using SLI data for the analysis area, an average snag density was obtained for each habitat type group. Habitat-Type Group C did not have SLI snag data collected for stands within the analysis area; therefore, the average was obtained by using stands within Swan River State Forest that had snag data recorded (the methodology is included in the project file). The acres of stands over 40 years old were multiplied by the average SLI snag densities in

TABLE F-4 - ESTIMATED HISTORICAL SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING HARRIS (1999)

HABITAT TYPE GROUP	**ACRES IN ANALYSIS AREA (OVER 40 YEARS OLD)**	**AVERAGE DENSITY OF LARGE SNAGS ON UNCUT STANDS IN *HARRIS (1999)* (NUMBER OF PLOTS SAMPLED)**	**TOTAL ESTIMATED LARGE SNAGS IN ANALYSIS AREA**	**AVERAGE DENSITY OF MEDIUM SNAGS ON UNCUT STANDS IN *HARRIS (1999)* (NUMBER OF PLOTS SAMPLED)**	**TOTAL ESTIMATED MEDIUM SNAGS IN ANALYSIS AREA**
B	80	0.5 (181)	40	1.4 (181)	112
C	90	0.5 (122)	45	1.4 (122)	126
D	4,775	1.2 (102)	5,730	3.9 (102)	18,623
E	3,789	0.9 (284)	3,410	2.4 (284)	9,094
G	75	1.0 (33)	75	1.4 (33)	105
H	228	0.5 (33)	114	2.4 (33)	547
I	69	0.8 (202)	55	4.6 (202)	317
J	30	1.0 (41)	30	2.3 (41)	69
Total	10,636		9,499		28,993
Average snags/ acre			0.89		2.73

TABLE F-5 - ESTIMATED EXISTING SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING SLI DATA

HABITAT TYPE GROUP	**ACRES IN PROJECT AREA (OVER 40 YEARS OLD)**	**AVERAGE LARGE SNAG DENSITY ESTIMATE BASED ON SLI DATA**	**TOTAL ESTIMATED LARGE SNAGS**	**AVERAGE MEDIUM SNAG DENSITY ESTIMATE BASED ON SLI DATA**	**TOTAL ESTIMATED MEDIUM SNAGS**
B	80	1.0	80	10.0	800
C*	90	5.5	495	5.5	495
D	4,775	3.5	16,713	7.6	36,290
E	3,789	4.0	15,156	5.8	21,976
G	75	1.7	128	10.0	750
H	228	1.7	388	4.5	1,026
I	69	2.0	138	9.7	669
J	30	2.0	60	11.0	330
Total	10,636		33,158		62,336
Average snags/acre			3.12		5.86

**Habitat group C did not have SLI snag data collected for stands. An average was obtained using stands within Swan River State Forest that had snag data.*

the corresponding habitat-type group. This calculation resulted in a weighted average based on acres to estimate the current average snag density in the analysis area. Following this method, an average of 3.12 large snags per acre and 5.86 medium snags per acre occur in the analysis area (*TABLE F-5 - ESTIMATED EXISTING SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING SLI DATA*). This average density of large snags is 244 percent higher and the density of medium snags is 119 percent higher in the analysis area than the estimated historical level.

The higher density of snags in the analysis area over what would be expected historically is not surprising. The analysis area consists of predominantly older stands that have been, or are being, afflicted by insect and disease agents. In these stands, many of the older, larger trees have succumbed to old age or the effects of insects and diseases, thereby increasing the snag densities experienced in the analysis area.

In addition to SLI data, snag data was collected in areas where SLI data indicated the stand might meet the old-growth definition of *Green et al. (1992)* and in other areas of interest using 1/5-acre fixed plots (data summaries can be found in the project file). Additional sampling was employed to gain a better understanding of the snag resources in stands being considered for harvests. Of the snags sampled, Douglas-fir, grand fir, and western larch were the most prevalent tree species encountered. In the larger (greater than 21 inches dbh) and medium (15 to 21 inches dbh) size classes, western larch and Douglas-fir provide the majority of snags, with western white pine the third most encountered snag species. Conversely, a majority of the smaller size class consists of Douglas-fir and grand fir snags. Small amounts of subalpine fir, Engelmann spruce, lodgepole pine, ponderosa pine, and western red cedar were noted and occurred across the size classes. The abundance of shade-intolerant snag species in the large size classes reinforces the effects of age and insect and disease agents afflicting mortality on these species. In the smaller size class, grand fir is becoming a more prevalent snag species, indicating a shift in proportions of shade-intolerant to shade-tolerant tree species in the analysis area (*FIGURE F-6 - SUMMARY OF SNAGS BY SIZE CLASS AND BY SPECIES SAMPLED WITHIN THE ANALYSIS AREA*).

To estimate snag losses for each stand proposed for harvesting under the action alternatives, the anticipated amount of snag loss was subtracted from the estimated amount of snags existing from *TABLE F-5 - ESTIMATED EXISTING SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING SLI DATA*. Snag loss was estimated based on the best site-specific data. More rigorously collected sampling plot data is believed to provide better site-specific estimates than the SLI data. So, where sampling data were present (see the project file for stands sampled and summarized data), the mean snag density was used to assess the snag loss and retention

TABLE F-6 - MINIMUM SNAGS DENSITIES (SNAG/ACRE) WITHIN THE ANALYSIS AREA (THREE CREEKS TIMBER SALE PROJECT AREA) FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE

	ALTERNATIVE				
	A	**B**	**C**	**D**	**E**
Estimated historic density of medium snags *(Harris 1999)*	2.73	2.73	2.73	2.73	2.73
Average density of medium snags following harvests (15 to 21 inches dbh)	5.86	5.13	5.12	4.93	4.81
Percent reduction of medium snags	0%	12.5%	12.7%	15.9%	18.0%
Estimated historic density of large snags (*Harris 1999*)	0.89	0.89	0.89	0.89	0.89
Average density of large snags following harvests (less than 21 inches dbh)	3.12	2.79	2.85	2.78	2.79
Percent reduction of large snags	0%	10.5%	8.8%	10.7%	10.5%

in that harvest unit. Where sampling data were lacking, the mean of the SLI snag density for the specific habitat type group was used to assess snag loss and retention. Under all action alternatives, a minimum of 2 snags and 2 snag-recruit trees greater 21 inches dbh would be retained (*ARM 36.11.411*) in all harvest units. If not enough snags larger than 21 inches dbh are available, then the balance needed to meet the 2 snags per acre rule would be retained from the medium size class. The number of snags needed to meet *ARM 36.11.411* were removed from the calculated snag loss, with the assumption that all other snags in the harvest unit would be harvested. This assumption likely underestimates snags that would remain since additional snags could be retained in retention patches required for grizzly bear cover and scattered throughout the units. However, the number of additional snags to be retained and the number lost through various attrition sources are not known. Therefore, to assess the effects of these alternatives, the minimum retention requirements under *ARM 36.11.411* were assumed to disclose the maximum level of effect due to snag loss. Any retention of additional snags would lessen the effects stated.

Predicted Effects to Snag Structure

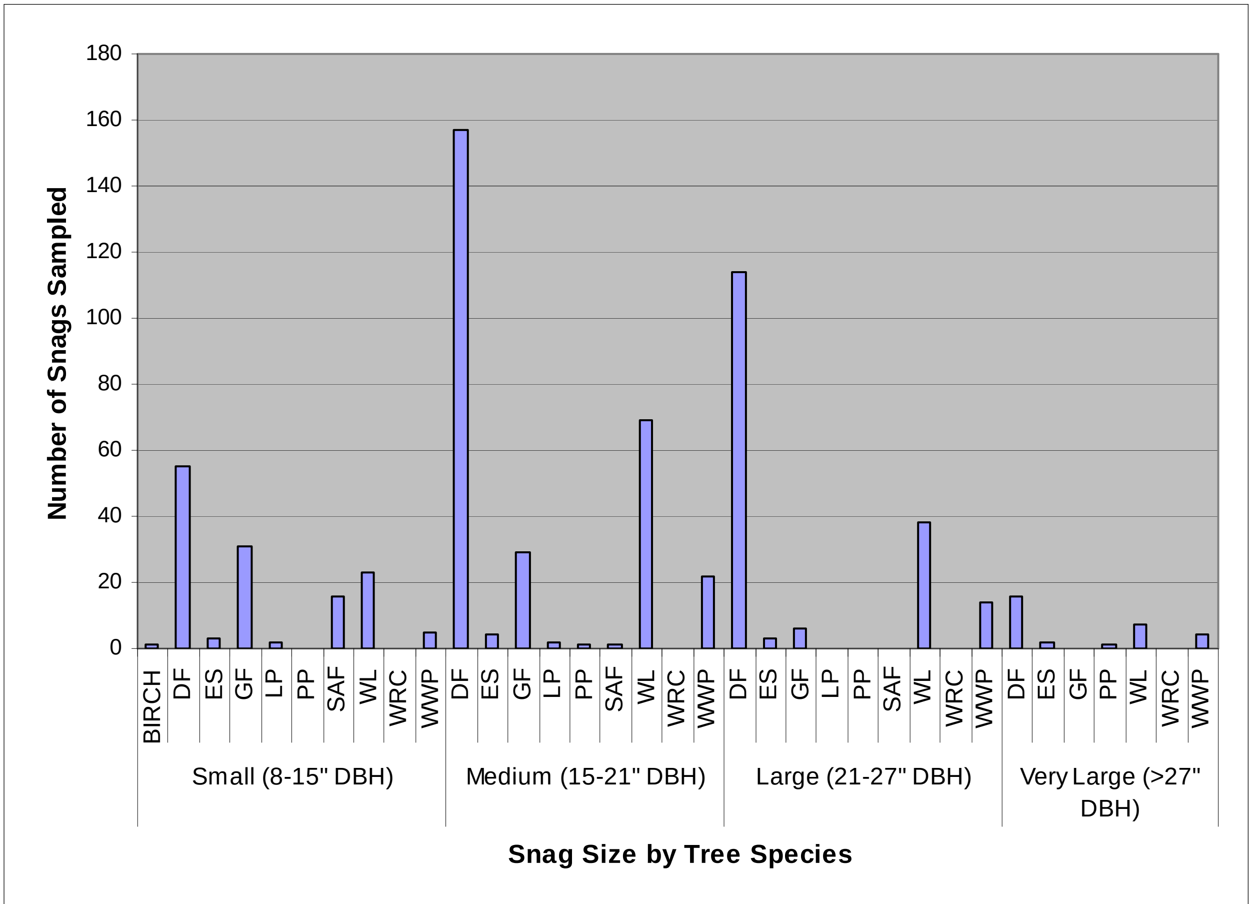
- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Snag Structure***

  No changes in snag density would occur due to timber-harvesting activities. Tree mortality, especially in shade-intolerant tree species, could increase due to the age of the stands, insect infestations, disease infections, or other natural events. This situation would continue to increase snag densities in the analysis area. Presently, average snag densities in Habitat Type Group D and E, which make up the majority of habitat-type groups in the project area, show elevated densities of snags in the larger size classes. A majority of these snags are western larch and Douglas-fir. Full retention of these snag densities is expected to benefit or retain current habitat for species that use deadwood resources in the short term. In the longer term, shade-intolerant snag species are expected to decline and not be replaced due to the lack of reproduction of these species in the analysis area. The reduction in shade-intolerant species, over time, could reduce nesting structure and available cavities for secondary cavity users. The increase in shade-tolerant species is expected to contribute to snag densities through time. However, since the length of time between shade-tolerant tree species becoming soft enough for cavity excavation and the time they fall to the ground is relatively short compared to shade-intolerant species, the length of time that these snag species provide secondary cavity-nesting habitat are expected to be relatively short term.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Snag Structure***

  In all units proposed under these alternatives, decreases in feeding and nesting sites are expected to occur due to the harvesting of snags (*FIGURE F-6 - SUMMARY OF SNAGS BY SIZE CLASS AND BY SPECIES SAMPLED WITHIN THE ANALYSIS AREA*). Within the harvest units, a minimum of 2 snags per acre would be retained. If adequate preharvest large-snag densities exist in the harvest units, these snags would be retained from the large size class. In the event that adequate densities of preharvest snags are lacking, all large snags would be retained with the balance needed to meet *ARM 36.11.411* being retained from the medium size class. All retention snags would be marked to leave. If snags planned for retention were felled for safety

FIGURE F-6 - SUMMARY OF SNAGS BY SIZE CLASS AND BY SPECIES SAMPLED WITHIN THE ANALYSIS AREA



Birch = Paper, water, or bog birch
DF = Douglas-fir
ES = Engelmann spruce
GF = Grand fir
LP = Lodgepole pine
PP = Ponderosa pine
SAF = Subalpine fir
WL = Western larch
WRC = Western red cedar
WWP = Western white pine

concerns, these snags would be left on site and/or a replacement snag could be designated to leave for the purpose of providing feeding substrate and habitat structure for wildlife species. Operational and safety losses of retention snags are expected to be higher in the cable and helicopter units as compared to the ground-based units due to safety concerns relating to sawyers and other workers being injured from an increased risk of knocking over snags while yarding the trees from the steep units. In these units, close sale administration would be needed to ensure snag-retention requirements are met.

The retention of 2 snags per acre in the large size class approximates the densities reported by *Harris (1999)*; therefore, densities of large snags would decrease under these alternatives, but the approximate historical average density would be retained within each harvest unit. Therefore, nesting and foraging sites would be reduced to near-average historic levels resulting in a low risk of decreasing survival or reproduction of species that need large snags to fulfill

their life requirements. However, the heavy reduction in densities of medium and small snags could result in moderate risks to decreasing foraging and feeding opportunities by cavity-nesting species, resulting in reduced survival and reproduction in the harvest units. These effects are likely to last for 80 to 100 years in regeneration units and 20 to 50 years in commercial-thin units, at which time leave trees could start appreciably contributing to snag development.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Snag Structure***

Large- and medium-sized snags would be harvested from units within the analysis area. A majority of these trees would be Douglas-fir and grand fir, which primarily are used for feeding (*Bull et al. 1997*). Even after considering the reductions in snag abundance under this alternative (*TABLE F-6 - MINIMUM SNAGS DENSITIES [SNAGS/ ACRE] WITHIN THE ANALYSIS AREA (THREE CREEKS TIMBER SALE PROJECT AREA) FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE*), snag densities in the analysis area would still be substantially more than would be expected by applying the average densities found in western Montana by *Harris (1999)* for large (0.89 snags per acre) and medium (2.73 snags per acre) snags. Therefore, habitat attributes of adequate large and medium snags would be retained in the analysis area, albeit reduced. Based on the existing high densities of snags in the analysis area, the reduction expected under any alternative would not likely affect the ability of the analysis area to support species that require snag structure. However, the reduction in snag structure and forest modification caused by the proposed harvesting could lead to habitat shifts away from the harvest units. These shifts could result in lower use of the harvest units and higher use of other areas within the analysis area that contain higher densities of snags and denser canopy closures. In some cases, these shifts could reduce the number of individuals that live and breed in the analysis area. In the long-term (80 to 100 years), the regeneration units are expected to start contributing shade-intolerant snag structure that would otherwise be reduced in the analysis area due to the lack of current reproduction. The increased production of snags of shade-intolerant species could result in benefits to cavity-nesting species by increased high-quality nesting structure.

No other projects are planned at the present time or within the foreseeable future within the analysis area. Public firewood cutting occurs in the analysis area and is generally confined to sites adjacent to open roads. Due to the high amount of dead and dying trees in the area and the limited access into the analysis area, firewood cutting is expected to result in small reductions of snags that result in negligible cumulative effects.

Considered in conjunction with other past, present, and future activities, each of the proposed action alternatives would likely result in minor cumulative effects to snag structure due to the retention of high densities of snags (large and medium size classes) in adjacent stands and the retention of the historical average density of large snags within the harvest units.

FINE-FILTER ANALYSIS

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species listed under the Endangered Species Act, species listed as sensitive by DNRC, and species managed as big game by DFWP.

THREATENED AND ENDANGERED SPECIES

- **Bald Eagle**

  No bald eagle nests are in the area, and bald eagles do not regularly inhabit the project area. Since no effects to bald eagles or their habitat are expected under any alternative, bald eagles were dropped from further analysis.

- **Canada Lynx**

  Issue

  Activities associated with timber harvesting could result in displacement of lynx from suitable habitat, which could lessen their ability to acquire adequate prey and/or successfully reproduce.

  Dismissed

  All action alternatives would result in increased human presence and disturbance associated with timber-harvesting activities. Because lynx appear to be relatively tolerant of human presence and road use (*Mowat et al 2000*) and do not appear to avoid roads at low traffic volumes (*Ruediger et al. 2000*), none of the action alternatives are expected to result in displacement or increase the energetic cost of individual lynx. Therefore, all alternatives are expected to result in very minor risks of displacing lynx from suitable habitats that could reduce their ability to survive and reproduce in the analysis area.

  Issue

  Timber harvests would remove canopy closure or alter stand conditions, which could result in the reduction or modification of habitat components leading to decreased ability for the area to support lynx.

Existing Condition

Canada lynx are listed as "threatened" under the *Endangered Species Act*. Currently, no recovery plan exists for Canada lynx, but a draft recovery plan outline has been written (*USFWS 2005*) and is being further developed and considered by USFWS. In addition, USFWS published a draft rule proposing designation of critical habitat for Canada lynx. DNRC-managed lands within the project area, which occur above 4,000 feet elevation, are included in the proposed critical habitat designation. USFWS was instructed through a court order to propose critical habitat by November 1, 2005 and issue a final rule for critical habitat by November 1, 2006 (*Fed. Reg. Vol. 70, No. 216 Nov. 9, 2005*). If critical habitat is designated for a species, *section 7(a)(2)* of the *Endangered Species Act* requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or destroy or adversely modify its critical habitat. Requirements associated with designation of critical habitat for lynx would not be implemented until after formal adoption of the final rule, which is currently scheduled to occur by November 1, 2006. The rule does not apply to State agencies unless they are conducting activities that require Federal funding or Federal permitting. Due to the critical habitat proposal being in the draft stage of the process, the fact that the designation could change substantially following the public comment stage of the process, and the fact that no Federal permitting or funding

would be associated with this project, DNRC anticipates that no aspect of this project or selection of any of the proposed action alternatives would be affected by the draft critical habitat rule for Canada lynx.

Lynx are associated with subalpine fir forests in western Montana (*Ruediger et al. 2000*). Lynx habitat in western Montana consists primarily of coniferous forests with plentiful snowshoe hares, stands with abundant coarse woody debris for denning and cover for kittens, and dense forested cover for travel and security. Additionally, mature forests provide habitat for red squirrels, an alternative prey source. These conditions are found in a variety of habitat types, particularly within the subalpine fir series (*Pfister et al 1977*).

The South Fork Lost Soup Grizzly Bear Subunit was used as the analysis area to assess the effects of this project on lynx. This scale of analysis approximates the home range size of a lynx (*Ruediger et al. 2000*). The 29,884-acre South Fork Lost Soup Subunit is comprised of 18,327 acres (61.3 percent) of State trust lands, 11,010 acres (36.8 percent) of USFS, 408 acres (1.4 percent) of private, and 139 acres (0.5 percent) of lands managed by Plum Creek Timber Company. The project area is located on the eastern portion of the DNRC-managed lands in the analysis area. This area occurs on the slopes above the valley bottom and continues into the higher elevations. The changes proposed under each alternative are considered at the cumulative-effects analysis area in addition to other past, present, and foreseeable future actions that could affect lynx habitat.

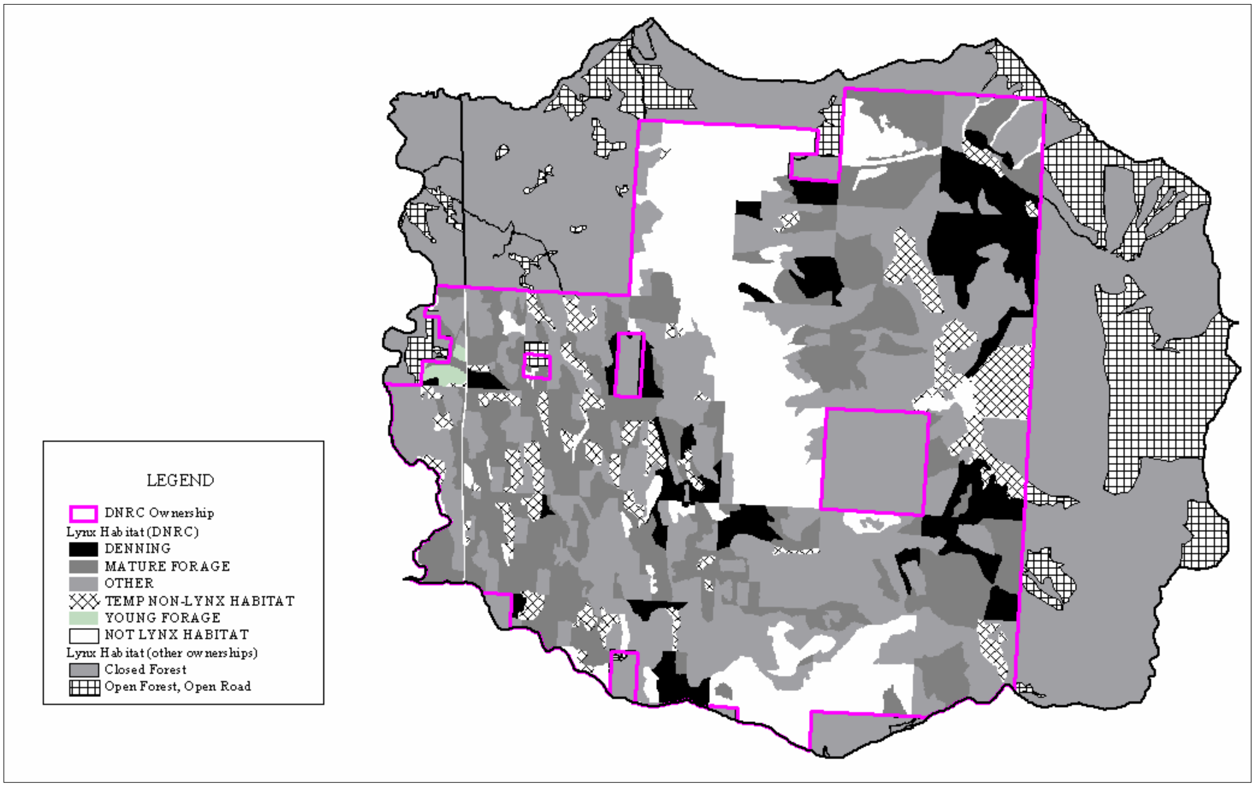
To assess lynx habitat, the DNRC lynx mapping protocol was applied to SLI data to determine the amount and proportions of lynx habitat elements present in the cumulative-effects analysis area. Lynx habitat (*ARM 36.11.403(40)*) was assigned to a stand if the SLI data indicated habitat types (*Pfister et al. 1977*) that are consistent with those reportedly used by lynx (*Ruediger et al. 2000*). Lynx habitat was further broken down into 5 specific habitat elements:

1) denning,
2) young foraging,
3) mature foraging,
4) “other” habitat, and
5) temporary non-lynx habitat using stand characteristics such as stand age, canopy cover, amount of coarse woody debris, etc.

Denning habitat provides important structure needed to provide denning sites and security for juvenile lynx, while foraging habitat is critical for the survival of both adult and juvenile lynx. “Other” habitat is a general habitat category that provides for secondary prey items and contains modest levels of forest structure usable by lynx. Temporary non-lynx habitat consists of nonforest and open forested stands that are not expected to be used by lynx until adequate horizontal cover reestablishes.

DNRC-managed lands support lynx habitat on 14,457 acres (78.9 percent of DNRC-managed lands within the South Fork Lost Soup Subunit analysis area). The current distribution of lynx habitat elements on DNRC-managed lands is a result of, primarily, past timber harvesting and the lack of recent wildfire activity (*FIGURE F-7 - EXISTING DISTRIBUTION OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS AND POTENTIAL LYNX HABITAT ON ADJACENT LANDS*). Forest-management practices over the past 40 to 60 years produced the current amount

FIGURE F-7 - EXISTING DISTRIBUTION OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS AND POTENTIAL LYNX HABITAT ON ADJACENT LANDS



of temporary unsuitable and young foraging habitat. Stands that were precommercially thinned on DNRC-managed lands would be considered "other" habitat and not young foraging habitat in accordance with the DNRC lynx-mapping protocol. Harvests conducted over 15 years ago likely recovered to the point of at least providing "other" habitat. In addition, the lack of fire, including the effects of fire suppression, led to the development and maintenance of mature foraging, "other", and denning habitat. The resulting acreage and proportions of the DNRC lynx-mapping protocol are shown in *TABLE F-7 - EXISTING ACREAGE AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE SOUTH FORK LOST SOUP SUBUNIT CUMULATIVE-EFFECTS ANALYSIS AREA*. Specific lynx use of the analysis area is unknown.

TABLE F-7 - EXISTING ACREAGE AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE SOUTH FORK LOST SOUP SUBUNIT CUMULATIVE EFFECTS ANALYSIS AREA

LYNX HABITAT ELEMENT	DNRC-MANAGED LANDS WITHIN THE SOUTH FORK LOST SOUP SUBUNIT ANALYSIS AREA (PERCENT OF LYNX HABITAT)
Denning	1,868 (12.9%)
Mature foraging	4,591 (31.8%)
Other	6,573 (45.5%)
Temporary nonhabitat	1,371 (9.5%)
Young foraging	54 (0.4%)
Grand Total	14,457 (100.00%)

However, modeling indicates that lynx habitat is available in adequate proportions and lynx tracks have been documented on several occasions in the South Fork Lost Creek and Soup Creek drainages (*T. Their, DFWP, pers. comm. 2/14/06; M. Parker, Northwest Connections, pers. comm. 11/18/05*). This evidence indicates that lynx could be using, or at least traveling through, the analysis area.

The past management actions on adjacent lands in the subunit tend to follow those discussed above for DNRC-managed lands. Based on interpretation of aerial photographs, approximately 8,909 acres of adjacent lands provide forested habitats with greater than 40-percent canopy closure, providing stand conditions that could support lynx habitat. The remaining 2,648 acres is comprised of regenerating timber stands and natural openings. A portion of these regenerating timber stands and natural openings likely provide some level of foraging habitat for lynx.

Predicted Effects to Canada Lynx

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Canada Lynx***

  No lynx habitat would be affected in the project area. Additionally, no other projects are expected to alter the distribution of habitat elements on State or adjacent ownerships. Therefore, in the short-term, no changes in habitat elements are expected within the cumulative-effects analysis area. In the longer term (barring natural disturbances), temporary non-lynx habitat (1,371 acres) could develop into young foraging habitat or "other" habitat. Concurrently, young foraging habitat (54 acres) could mature into "other" habitat. The amount of developing young foraging habitat (1,371 acres) is expected to exceed the amount of young foraging habitat that would mature into "other" habitat. Therefore, snowshoe hare prey availability is expected to increase within the next 10 to 20 years. However, after this time period, young foraging habitat is expected to decline because no regenerating stands would replace the stands succeeding out of young foraging habitat. When this occurs, habitat quality for snowshoe hares could decline, thereby reducing the availability of prey for lynx. As these young foraging stands mature, habitat for red squirrels could increase, slightly lessening the effect of reduced snowshoe hare prey. However, a diet of red squirrels might not provide the nutrients needed for the successful reproduction and rearing of kittens (*Koehler 1990*). Mature foraging and denning habitats are expected to remain at current proportions or increase in the future as shade-tolerant trees develop in the understory and coarse woody debris accumulates through time due to natural events. "Other" habitat is expected to increase in the future as temporary non-lynx and young foraging habitat matures into this habitat element. Therefore, in the short term, no effects to lynx are expected. In the longer-term, without disturbance, young foraging opportunities could decrease. However, mature stands that contain dense horizontal cover could offset or compensate for these loses.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Canada Lynx***

  Each alternative would alter lynx habitat in the analysis area. Harvests using seedtree, seedtree-with-reserves, and shelterwood prescriptions are

expected to remove canopy and horizontal cover to prepare for regenerating trees. These prescriptions would convert available lynx habitat elements to temporary non-lynx habitat. Conversely, commercial-thin prescriptions would retain greater than 40-percent canopy cover, thereby converting any specific lynx habitat element into the "other" category. Existing young foraging habitat would not be affected (*TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE-EFFECTS ANALYSIS AREA).* All treated acres affected would retain 15 to 20 tons of coarse woody debris and 1 slash pile per harvest unit on site to provide some horizontal and security structure for lynx. In harvest units adjacent to open roads, slash piles would not be left due to public safety concerns. In the short-term, lynx would likely avoid harvest units that were converted to temporary non-lynx habitat, resulting in habitat usage shifts away from the regeneration units. Use of the commercial-thin units is expected to continue at some level.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Canada Lynx***

Each alternative alters the amounts and proportions of lynx habitat elements in the analysis area. Denning habitat would be reduced under all alternatives (*TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA*). However, following implementation of each alternative, enough lynx denning habitat would be retained on DNRC-managed lands to satisfy DNRC's commitment of retaining

TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA

CHANGES TO LYNX HABITAT CAUSED BY TREATMENTS	ALTERNATIVE				
	A	B	C	D	E
Denning Habitat converted to Temporary Non-Lynx Habitat	0	-163	-145	-171	-105
Mature Foraging Habitat converted to Temporary Non-Lynx Habitat	0	-217	-4	-456	-460
Other Habitat converted to Temporary Non-Lynx Habitat	0	-97	-275	21	-54
Total increase in Temporary Non-Lynx Habitat	*0*	*+477*	*424*	*605*	*618*
Denning Habitat converted to Other Habitat	0	0	0	-85	0
Mature Foraging Habitat converted to Other Habitat	0	-71	0	-107	-136
Other Habitat treated but remaining as Other Habitat	0	83	83	25	160
Total Other Habitat resulting from treatments	*0*	*154*	*83*	*217*	*296*
Changes to Young Foraging Habitat	0	0	0	0	0
Total Lynx Habitat Affected	*0*	*632*	*507*	*823*	*914*

5-percent lynx habitat in the denning-habitat element (*ARM 36.11.435*). (*TABLE F-9 - ACRES AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE CUMULATIVE EFFECTS ANALYSIS AREA [SOUTH FORK LOST SOUP SUBUNIT] FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE*). No other DNRC concurrent or foreseeable future projects are expected to alter denning habitat in the analysis area. In addition to denning habitat on DNRC-managed lands, denning habitat is likely to occur within some portion of the 8,909 acres of adjacent lands, thereby adding to the amount of denning habitat in the analysis area. None of this potential habitat on adjacent lands is planned for harvesting in the near future (2007 to 2009). In addition, insects and diseases continue to cause mortality of trees in the area, which could lead to the additional development of denning habitat. Conversely, public firewood harvesting could reduce denning structure primarily along open roads. Implementation of any of these alternatives presents a low risk of interfering with reproduction of lynx in the analysis area.

All alternatives would reduce mature foraging habitat and would not change young foraging habitat on 54 acres (*TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA*). Following implementation of this alternative, adequate proportions of foraging habitat on DNRC-managed lands would be retained (*TABLE F-9 - ACRES AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE CUMULATIVE EFFECTS ANALYSIS AREA [SOUTH FORK LOST SOUP SUBUNIT] FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE*). Implementation of any alternative satisfies DNRC's commitment to foraging habitat under *ARM 36.11.435*. In addition to foraging habitat on DNRC-managed lands, foraging habitat is likely to occur within some portion of the 8,909 acres with greater than 40-percent canopy cover and the 2,648 acres of open forest (assuming that they have adequate horizontal cover) of adjacent lands. None of this potential habitat on adjacent lands is planned for harvesting

TABLE F-9 - ACRES AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE CUMULATIVE EFFECTS ANALYSIS AREA (SOUTH FORK LOST SOUP SUBUNIT) FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE

LYNX HABITAT ELEMENT	**ACRES OF LYNX HABITAT (PERCENT OF LYNX HABITAT) ELEMENTS FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE CONSIDERED**				
	A	**B**	**C**	**D**	**E**
Denning	1,868 (12.9%)	1,705 (11.8%)	1,723 (11.9%)	1,612 (11.2%)	1,763 (12.2%)
Mature foraging	4,591 (31.8%)	4,303 (29.8%)	4,587 (31.7%)	4,028 (27.9%)	3,995 (27.6%)
Other	6,573 (45.5%)	6,547 (45.3%)	6,298 (43.6%)	6,744 (46.7%)	6,655 (46.3%)
Temporary nonhabitat	1,371 (9.5%)	1,848 (12.8%)	1,795 (12.4%)	1,976 (13.7%)	1,989 (13.8%)
Young foraging	54 (0.4%)	54 (0.4%)	54 (0.4%)	54 (0.4%)	54 (0.4%)
Total lynx habitat	*14,457*	*14,457*	*14,457*	*14,457*	*14,457*

in the near future (2007 through 2009). In 10 to 20 years, acres converted to temporary non-lynx habitat are expected to regenerate into young forage, which would result in an increase in foraging habitat available in the analysis area. Therefore, all alternatives would result in a low risk of reducing foraging opportunities to the point where a lynx could not survive in the area, and, in the longer-term, this alternative could result in a minor beneficial effect by increasing foraging habitat for 10 to 30 years.

In the short-term, available lynx habitat would be converted to temporary non-lynx habitat on DNRC-managed lands in the analysis area (*TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA*). No other DNRC project or projects on adjacent lands are expected to convert any additional suitable lynx habitat to temporary non-lynx habitat; therefore, no additional habitat conversion is expected. As these stands regenerate young trees in 10 to 20 years, young foraging habitat is expected to develop. This habitat element provides habitat for snowshoe hares, which, in turn, lynx prey upon. Regenerating stands provide high quality snowshoe hare habitat until the branches of the trees no longer provide horizontal cover at the ground or snow level, which is expected to occur in 10 to 30 years following the successful regeneration of young trees. If these regenerating stands were precommercially thinned prior to this point, or if regeneration was less dense, they would be considered “other” habitat. In either case, the amount of temporary non-lynx habitat would decrease. Some portion of the existing 1,371 acres (9.5 percent) temporary non-lynx habitat would likely convert to young foraging or other habitat in the near future, thereby offsetting the loss of habitat under these alternatives to some degree. Regardless of the conversion of existing temporary non-lynx habitat to usable habitat, each alternative, in combination with other activities in the analysis area, is expected to retain enough usable habitat for a lynx to survive and reproduce in the analysis area. Therefore, the risk of preventing lynx use and reproduction in the analysis area would be low under any of the action alternatives.

All action alternatives would result in a short-term reduction in lynx habitat. However, adequate amounts of habitat in suitable proportions of habitat (denning and foraging habitat) would be retained. In 10 to 20 years, each action alternative could result in increased young foraging habitat that could provide increased snowshoe prey availability for 10 to 30 years. Therefore, all action alternatives are expected to result in a low risk of reducing the ability of a lynx to survive and reproduce in the area in the short-term (10 to 20 years), and could benefit lynx in 10 to 20 years by increasing foraging habitat as the harvested stands regenerate and provide snowshoe hare habitat.

Other actions that may occur in the analysis area that could be cumulative to the proposed alternatives include the continued effects from insect and disease agents, future harvesting activities on neighboring ownerships, fire

suppression, and bobcat trapping.

Concurrently, insect and disease agents continue to kill trees in the analysis area, which results in increased recruitment of coarse woody debris, resulting in a possible increase in den sites. Public firewood cutting (usually adjacent to open roads) on all ownerships would reduce recruitment of coarse woody debris in those areas. However, the removal of dead and dying trees are not expected to appreciably alter the amount of suitable lynx habitat, but could reduce local accumulations of coarse woody debris available for denning sites and the development of denning habitat. However, denning habitat does not appear to be limiting in the subunit; therefore, no substantial additional effects are expected in addition to the effects discussed under each alternative above.

No additional harvesting activities are planned on neighboring ownerships in the cumulative-effects analysis area during the 3-year active period. However, fire-suppression activities would continue to reduce the potential for stand-replacing wildfires, which could limit the natural development of young foraging habitat in the future. Therefore, the only foreseeable potential for the development of young foraging habitat would be through the proposed harvests.

Currently, 1 trapper has a permit to lawfully set traps for bobcats, consistent with DFWP trapping regulations, on DNRC-managed lands in the analysis area. Incidental captures are possible, but not expected. In the event that a lynx is captured, the trapper is obligated to release the animal without harm. Therefore, no additional impacts from trapping are expected.

Considered in conjunction with other past, present, and future activities, any of the proposed action alternatives would likely result in minor cumulative effects to Canada lynx.

- **Gray Wolf**

Issue

Gray wolves could be affected by disturbance at key locations (denning/rendezvous sites) during harvesting, which could result in an increased risk to wolf pups.

Dismissed

Wolves are most vulnerable to human disturbance at den and rendezvous sites from April through September. Denning and rendezvous sites are unlikely to occur in the project area due to the steep topography and the presence of more suitable den sites outside the project area in the nearby valley bottom. If a wolf den were located, DNRC would temporarily suspend all mechanized activities and administrative uses, over which DNRC has control, in areas that are within a one-mile radius of the den until such time as wolves are known to have vacated the site or it has been determined that resumption of activities would not present conflicts with wolf use (*ARM 36.11.430[1][a][i]*). Harvesting activities would generally occur outside of the spring period (April 1 through June 15), thereby further limiting the risk of disturbance to wolves at den sites. When harvests become active in mid-June, wolves would likely have moved their pups to rendezvous sites, where human disturbance could also be harmful. If a rendezvous site were located, DNRC would temporarily suspend operations within 0.5 mile of the site until it is determined that resumption of activities will not

present conflicts with wolf use (*ARM 36.11.430[1][b]*). With these mitigations in place, this project is not expected to disrupt wolves at key locations. Therefore, a negligible risk to wolf pups would be expected under any alternative.

Issue

Gray wolves could be adversely impacted through increased motorized access due to road construction and a reduction in hiding cover, which could result in increased risk of human/wolf conflicts and subsequent mortality of wolves.

Issue

Timber harvesting could alter habitat and reduce the ability of the project area to support wolves by decreasing the carrying capacity of the winter range for native ungulates.

Existing Condition

The gray wolf is listed as "endangered" under the Endangered Species Act in the northern portion of Montana, which includes the project area. To meet the delisting criteria, the 3 recovery areas need to support a minimum of 30 breeding pairs for 3 consecutive years. The 3 recovery zones have met the recovery objectives for breeding pairs since 2000. In 2005, 71 packs were documented within the tri-state region (*USFWS et al. 2006*). Of those 71 packs, 46 occurred in Montana, with 19 of those found in northern Montana portion of the recovery area (*Sime et al. 2006*). The delisting process is ongoing, and DFWP has assumed lead management authority over the species in Montana.

The wolf is a wide-ranging, mobile species. Adequate habitat for wolves consists of areas with adequate prey and minimal human disturbance, especially at den and/or rendezvous sites. Wolves prey primarily on white-tailed deer, and, to a lesser extent, elk and moose, in northwest Montana (*Kunkel et al. 1999*). Wolves typically den during late April in areas with gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas. When pups are 8 to 10 weeks old, wolves leave the den site and start leaving their pups at rendezvous sites while hunting. These sites are used throughout the summer and into the fall. When the pups are 5 to 6 months old, they start traveling with the pack (*DFWP 2003*). Disturbance at den or rendezvous sites could result in avoidance of these areas by the adults or force the adults to move the pups to a less adequate site. In both situations, the risk of pup mortality increases.

To analyze the cumulative effects to wolves, the South Fork Lost Soup Subunit was used. This analysis area represents the amount of area that a wolf pack may use during the summer months while raising their pups (*Mech 1987, Ream et al. 1988*). Therefore, if a denning site occurred in the analysis area, wolf use would likely remain within the analysis area. Outside the denning and rearing period, the pups travel with the pack and home ranges can expand greatly (*Mech 1970, FWP 2003, USFWS et al. 2006*). The South Fork Lost Soup Subunit includes the project area and the valley floor, which contains approximately 6,613 acres of elk and mule deer composite winter range. No white-tailed deer winter range occurs in this subunit. Wolf tracks and sightings have occurred in and near the project area within the last 2 years; however, no denning activity has been documented (*USFWS et al. 2006, K.Lauden, pers.comm.3/20/06*). Transitory or sporadic wolf use is expected to

continue in the project area. Due to the topography and the lack of white-tailed deer winter range, denning and rendezvous sites are not expected to occur within the project area, but may be established in the valley bottom where habitat conditions are favorable. Wolf use of the project area would probably be associated with foraging or traveling activities.

In addition, this subunit is cooperatively managed for grizzly bear habitat and access. Actions taken by the cooperators to manage motorized access, hiding cover, visual screening along open roads, and spring harvest restrictions to project grizzly bears also benefit wolves. Currently, 31.2 percent of the analysis area exceeds 1 mile per square mile open-road density and 79 percent of the analysis area provides hiding cover. In addition, 49.6 miles of restricted road occurs within the cumulative-effects analysis area. Cattle and sheep grazing operations can be a source of human/wolf conflict; however, no livestock grazing leases or licenses occur within the cumulative-effects analysis area.

Predicted Effects to Gray Wolves

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Gray Wolves***

  The existing vegetation and human access in the project area are not expected to be altered; therefore, no effects on wolves are expected.

- ***Direct and Indirect Effects to Gray Wolves Common to Action Alternatives B, C, D, and E***

  The risk of human/wolf conflicts and/or wolf mortality in the project area could be increased through additional human access and reduced hiding cover attributable to new road construction and logging operations. Under all alternatives, a range of 8.4 to 15.8 miles of new restricted road would be constructed to harvest the proposed units. Any new road would be managed as restricted, except for the new portion (1.7 miles) of South Fork Lost Creek Road. The old portion of this open road would be abandoned (1.3 miles). Timber harvesting could remove between 1,203 and 1,351 acres of hiding cover for 10 to 20 years, depending on the alternative chosen (*TABLE F-10 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF PERMANENT RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE*). To mitigate the risks associated with increased human access during logging operations and the reduction of hiding cover, regeneration units would be laid out, so that no point of any regeneration unit would be greater than 600 feet to cover, visual screening would be retained between open roads and regeneration units (seedtree and shelterwood harvest units), and contractors would not be allowed to carry firearms while on duty. Taken together, these

TABLE F-10 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF PERMANENT RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE

PARAMETER	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Hiding cover acres removed	0	1,274	1,203	1,351	1,322
Linear miles of permanent, restricted road	0	13.3	12.7	15.8	8.4

mitigations are expected to result in a low risk for human/ wolf conflicts or increased wolf mortality if wolves use the harvest units.

- ***Cumulative Effects to Gray Wolves Common to Action Alternatives B, C, D, and E***

Each alternative was analyzed at the South Fork Lost Soup Subunit analysis area level in the context of the existing condition. Under all action alternatives, open-road density would increase, hiding cover would decrease, and additional linear miles of restricted roads would be constructed, which could affect wolf use and the ability to survive in the analysis area.

Under all alternatives, the proportion of the analysis area that exceeds 1 mile per square mile open-road density would increase from 31.2 percent to 31.5 percent within the analysis area (*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE EFFECTS ANALYSIS AREA*). (Refer to the analysis on Grizzly Bear for analysis methods.) Since the increase is small and occurs due to the rerouting of a currently open road in the same area, this increase is expected to result in a low risk of increasing wolf mortality in the analysis area.

Implementation of any alternative would reduce the hiding cover in the analysis area by 4.8 to 5.4 percent for 10 to 20 years, depending on whether an action alternative is chosen and which one is chosen (*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE-EFFECTS ANALYSIS AREA*). Following implementation of any alternative, a high proportion of hiding cover (ranging from 75.2 to 74.8 percent) would still remain in the subunit. Concurrent salvage harvests on DNRC-managed lands are not expected to alter hiding cover, nor are any projects planned on adjacent lands that could reduce hiding cover. Although no threshold levels of hiding cover have been established for wolves (*USFWS et al. 2006*), the thresholds developed for grizzly bears (*SVGBCA 1997*) would likely also provide adequate security for wolves. Therefore, implementation of this alternative is expected to remove hiding cover, but result in a low risk of increased mortality to wolves using the analysis area.

TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE-EFFECTS ANALYSIS AREA (IE., SOUTH FORK LOST SOUP SUBUNIT)

PARAMETER	ALTERNATIVE				
	A	B	C	D	E
Percent Open-Road Density greater than 1 mile per square mile in the South Fork Lost Soup Subunit (% increase)	31.2% (0.0%)	31.5% (1.0%)	31.5% (1.0%)	31.5% (1.0%)	31.5% (1.0%)
Hiding Cover retained in the South Fork Lost Soup Subunit (% reduction)	79% (0.0%)	75.0% (5.1%)	75.2% (4.8%)	74.7% (5.4%)	74.8% (5.3%)
Linear miles of restricted roads (% increase)	49.6 (0.0%)	62.9 (26.8%)	62.3 (25.4%)	65.4 (31.9%)	58.0 (16.9%)

Additional permanent road access could lead to additional disturbance and/or mortality risk in the future. This alternative would increase the linear mileage of restricted roads from 49.6 to a range of 58.0 to 62.9 miles, a 16.9- to 26.8-percent increase (*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE-EFFECTS ANALYSIS AREA*). No other concurrent or foreseeable future projects on DNRC-managed or adjacent lands would construct new roads; therefore, only this project would increase road access. The presence and maintenance of restricted roads produces a long-term potential for additional disturbance to wolves and an increased risk of wolf/ human conflicts when compared to areas without road access. These disturbances would likely be associated with administrative and salvage harvests during inactive periods and could include commercial forest-management activities during active periods as dictated by the SVGBCA. Since mitigations are in place to protect key sites and restrict carrying firearms while on duty, these increases are likely to represent a negligible risk to increasing wolf mortality in the analysis area.

Overall, all alternatives protect key sites, retain considerable levels (74.7 to 75.2 percent of the analysis area) of hiding cover, maintain approximately the same level of public motorized access (small location shift of South Fork Lost Creek Road), restrict contractors from carrying firearms while on duty, and are not expected to affect big game populations (refer to the analysis on *BIG GAME*) in the analysis area. Therefore, each alterative presents a low risk to increasing mortality to wolves or substantially reducing their prey in the analysis area.

- **Grizzly Bear**

Issue

Activities associated with timber harvesting can alter cover, increase access, and reduce secure areas, which can adversely impact grizzly bears by displacing bears from preferred habitats and/or by increasing risk to bears of human-caused mortality.

Existing Condition

Grizzly bears, native generalist omnivores that use a diversity of habitats found in western Montana, are currently listed as "threatened" under the Endangered Species Act. Primary threats to grizzly bears are related to human-bear conflicts, habituation to unnatural foods near high-risk areas, and long-term habitat loss associated with human development (*Mace and Waller 1997*). Forest-management activities may affect grizzly bears by altering cover and/or by increasing access to humans into secure areas by creating roads (*Mace et al. 1997*). These actions can lead to displacement of grizzly bears from preferred areas and/or result in an increased risk of human-caused mortality by bringing humans and bears closer together and/or making bears more detectable, which can increase their risk of being shot illegally. Displacing bears from preferred areas may increase their energetic costs, which may in turn lower their ability to survive and/or reproduce successfully.

For decades, lands in the Swan Valley have been aggressively managed for timber production, the influences of which are evident when touring the valley or viewing recent aerial photographs of the area. Evidence of past activities

exists on USFS lands, corporate timberlands, and DNRC-managed State trust lands associated with the foothills and valley floor. Past activities have resulted in an obvious patchwork comprised of multiaged forest stands that are variously shaped, which exist at differing stages of successional development. Some old harvest units now contain productive berry patches and hiding cover; whereas, more recent clearcut and seedtree harvest units provide little in the way of forage or cover for bears. Other areas that have been lightly harvested, intensively harvested several decades ago, or never harvested do continue to provide ample levels of cover in the valley (*SVGBCA monitoring report 2004*). Extensive road systems that have been required over the years to facilitate intensive logging are also evident in the valley. These road systems have developed over the years and now provide a number of access routes into otherwise remote areas.

In Swan Valley, DNRC, USFS, Plum Creek Timber Company, and the USFWS collaborated to cooperatively manage grizzly bear habitat and access under the SVGBCA. Another main objective of the SVGBCA is to ensure connectivity across Swan valley through special management of linkage zones. Preliminary evaluation of data collected from radio-collared bears indicates that the use of the valley bottom by bears is occurring to facilitate linkage between the Bob Marshall Wilderness and Mission Mountain Wilderness bear populations. However, monitoring of radio-collared bears has also indicated a trend of high mortality rates in Swan Valley, primarily attributable to illegal human-caused mortality and management removals (*SVGBCA monitoring report 2004*).

Under the SVGBCA, a rotation of active and inactive subunits was devised. The rotation schedule allows for active subunits, where harvesting activities might displace grizzly bears, and inactive subunits, where commercial activities are prohibited to provide undisturbed habitat. These rotations occur on a 3-year-active and 6-year-inactive basis. The South Fork Lost Soup Subunit was scheduled to become active during the 2006 through 2008 period. However, DNRC requested, and was granted, an exception to the rotation period for the South Fork Lost Soup Subunit. Based on the exception, the South Fork Lost Soup Subunit would be active for the period of 2007 through 2009. This exception requires that no commercial activities occur in the South Fork Lost Soup Subunit for the 2006 nondenning period, and no commercial activities occur on DNRC-managed lands in the Lion Creek Grizzly Bear Subunit for the 2009 nondenning period.

When a subunit is active, harvesting activities would not occur during the spring period (April 1 through June 15) in spring habitat (areas within linkage zones below 5,200 feet). After the spring period, harvesting activity and associated road use can occur unrestricted in the active subunit. However, any restricted road used for commercial activities would require the restriction of public use through the placement of signs while harvesting activities are occurring and the placement of a barrier across the road when harvesting activities are not occurring (weekends, nights, inactive periods, etc.). Other stipulations under the SVGBCA include:

– retaining a 100-foot visual buffer between open roads and the even-aged harvest units,

- utilizing uneven-aged management in the riparian zones,
- laying out harvest units so that no point is greater than 600 feet to cover, and
- restricting contractors from carrying firearms while on duty.

In addition to the above stipulations, the SVGBCA provides defined standards for hiding cover and open-road density for each subunit and requires cooperators to track amounts of total-road density and secure habitat.

Cumulative effects of the alternatives considered under this proposal were analyzed at the South Fork Lost Soup Grizzly Bear Subunit scale. All analyses required by the SVGBCA are also reported at the grizzly bear management unit subunit scale, which approximates the home range size of a female grizzly bear. For the cumulative effects analysis, other past, present, and foreseeable future actions in the South Fork Lost Soup Subunit (all cooperators) and their effects in combination with this project on hiding cover, open-road density, total-road density, and secure habitat were considered. Past projects resulting in changes to hiding cover and the construction of roads are considered in the existing condition.

The SVGBCA requires each cooperator to manage their lands so that a minimum of 40 percent of each subunit supports hiding cover. Presently, hiding cover in the South Fork Lost Soup Subunit is comprised of 82 percent of DNRC-managed, 75 percent of USFS, and 57 percent of Plum Creek Timber Company lands, averaging (weighted on acres) 79 percent for the subunit. The other defined standard in the SVGBCA is open-road density. The SVGBCA requires cooperators to manage open roads so that no more than 33 percent of the subunit exceeds 1 mile per square mile of open-road density. Open-road density is calculated by using a moving-windows-analysis technique (*Ake 1994*). Presently, 31.2 percent of the subunit exceeds 1 mile per square mile of open-road density.

The SVGBCA does not contain a total-road density or secure habitat standard, but requires the cooperators to annually report these values by subunit. To measure total-road density, a moving-windows analysis was conducted to determine that 53.4 percent of the analysis area exceeds 2 miles per square mile. To measure secure habitat, the highway, open roads, gated roads, and high-use trails were buffered by 1,640 feet (500 meters). The buffered area was then subtracted from the subunit acreage to obtain the amount of potential secure habitat in the analysis area (*FIGURE F-8—EXISTING POTENTIAL SECURITY CORE HABITAT IN THE SOUTH FORK LOST SOUP SUBUNIT)*. To be considered secure habitat, the area in question needs to exceed 2,500 acres. This analysis yielded 32.2 percent of the analysis area in secure habitat.

Predicted Effects to Grizzly Bears

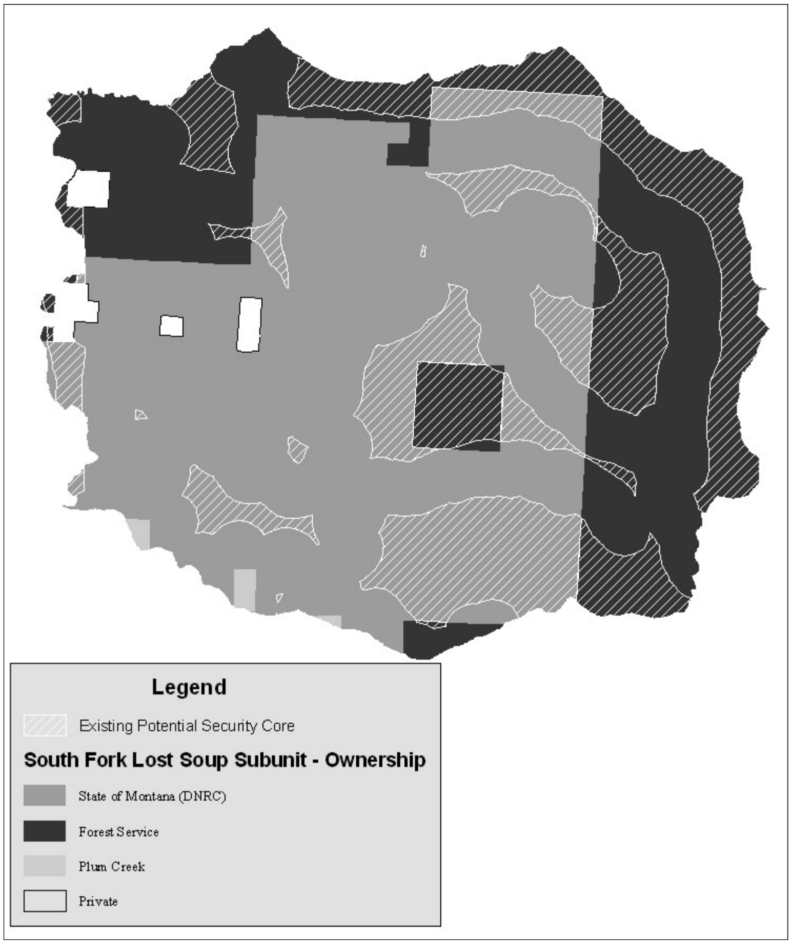
- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Grizzly Bears***

  No alteration of habitat attributes or increased human presence would occur; therefore, no changes in habitat use or human-caused mortality would be expected under this alternative.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Grizzly Bears***

  Under each alternative, a range of 1,203 to 1,351 acres of hiding cover would be removed by the implementation of seedtree and shelterwood silvicultural prescriptions (*TABLE F-12 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR*

FIGURE F-8 - EXISTING DISTRIBUTION OF FISHER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS



MILES OF RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE). To reduce the avoidance of harvest units and provide security if a bear uses the harvest unit, the seedtree and shelterwood harvest units would be laid out to ensure that no point of the unit exceeds 600 feet to cover and visual screening would be retained in a 100-foot strip between the harvest unit and an open road. With the mitigation measures in place, a low risk of avoidance of harvest units and a low risk to increased mortality while using the harvest units are expected. These effects would be expected to last until hiding cover reestablishes in 10 to 20 years.

The harvesting activities could result in short-term displacement effects, while construction of new roads could result in both short-term and long-term displacement effects. Under these alternatives, between 7.5 and 16 miles of new permanent roads and 3 to 7 miles of new temporary roads would be constructed (*TABLE F-12 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE*). All new permanent roads, except for 1.7 miles, would be managed as restricted. The 1.7 miles of new permanent road would be constructed to reroute the existing South Fork Lost Creek Road away from South Fork Lost Creek. Approximately 1.3 miles of the existing South Fork Lost Creek Road would then be

TABLE F-12 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE

PARAMETER	ALTERNATIVE				
	A	B	C	D	E
Acres of hiding cover harvested	0	1,274	1,203	1,351	1,322
Linear miles of permanent, restricted road constructed	0	13.3	12.7	15.8	8.4
Linear miles of temporary, restricted road constructed	0	5.2	6.6	3.9	4.6

abandoned, resulting in a 0.4-mile increase in open roads. The new permanent restricted roads would be blocked by a gate that would allow for administrative use. The new temporary roads would be blocked off with a berm (or like structure) that would prevent public and administrative motorized use. The effects of displacement during the active period (2007 through 2009) are expected to be mitigated by having inactive subunits within the Bunker Hill Bear Management Unit to provide relatively undisturbed areas for bears to displace into. Therefore, each alternative is expected to represent a minor risk to bear displacement that results in mortality. In the longer-term, bears could avoid habitat associated with the new roads, which would result in a loss of habitat. These effects will be discussed further under the cumulative effects section of this analysis.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Grizzly Bears***

  Under all alternatives, the amount of hiding cover retained in the subunit would be reduced from 79.0 percent to between 74.7 and 75.2 percent (a 5.1- to 4.8-percent reduction), depending on whether an action alternative is chosen and which one (*TABLE F-13 - RESULTS EXPECTED AFTER IMPLEMENTATION OF EACH ALTERNATIVE FOR HABITAT PARAMETERS IMPORTANT TO GRIZZLY BEARS*). In any case, the hiding cover amounts greatly exceed the 40-percent stipulation required by the SVGBCA. Additionally, DNRC is concurrently considering salvage harvests on an additional 120 acres in the analysis area. These harvests are not expected to alter hiding cover, so no additional changes in hiding cover is expected on DNRC-managed lands. Other cooperators (USFS and Plum Creek Timber Company) do not have plans for projects in this subunit during the 2007 through 2009 active period. Therefore, this alternative would result in small proportional reductions of hiding cover, resulting in negligible risk of reducing availability of grizzly bear habitat or increasing mortality risks to bears using the analysis area.

  All action alternatives would increase the open-road density the same amount within the South Fork Lost Soup Subunit. The rerouting of the South Fork Lost Creek Road and the abandonment of portions of the existing

TABLE F-13 - RESULTS EXPECTED AFTER IMPLEMENTATION OF EACH ALTERNATIVE FOR HABITAT PARAMETERS IMPORTANT TO GRIZZLY BEARS (estimates are for ownership of all SVGBCA cooperators within the South Fork Lost Soup Subunit analysis area)

PARAMETER	**SVGBC REQUIREMENTS**	**ALTERNATIVE**				
		A	**B**	**C**	**D**	**E**
Open-road density	No more than 33%	31.2%	31.5%	31.5%	31.5%	31.5%
Hiding cover retained	No less than 40%	79.0%	75.0%	75.2%	74.7%	74.8%
Linear miles of restricted roads	No limit	49.6	62.9	62.3	65.4	58.0
Total-road density	No limit	53.2%	58.3%	57.5%	59.9%	56.9%
Secure habitat	No limit	32.2%	29.7%	30.1%	28.9%	30.8%

roads would result in an increase in open-road density from 31.2 to 31.5 percent. This increase is within the 33-percent stipulation of the SVGBCA. The increase in open-road density is slight and within the same area already affected by this road; therefore, any additional risk of an increase in mortality or decrease in reproduction due to this change is likely to be negligible.

The presence and maintenance of restricted roads produces a long-term potential for additional disturbance to grizzly bears and increased risk of human-caused mortality when compared to areas without road access. Under all alternatives, the proportion of area affected by total-road density would increase and secure habitat would decrease (*TABLE F-13 - RESULTS EXPECTED AFTER IMPLEMENTATION OF EACH ALTERNATIVE FOR HABITAT PARAMETERS IMPORTANT TO GRIZZLY BEARS*). The increase in total-road density and decrease in secure habitat could result in increased disturbance of grizzly bears by nonmotorized dispersed recreation, administrative activities (including motorized), salvage harvests during inactive periods, and commercial forest-management activities during active periods. Since no stipulations for total-road density or secure habitat are noted in the SVGBCA, all alternatives are in compliance. The increase in total-road density and decrease in secure habitat could result in an increased risk of avoidance of suitable habitat and human/bear interactions. However, stipulations placed on contractors and DNRC personnel that restrict carrying firearms reduce the risk of additional mortality associated with administrative use. The availability of roads could increase nonmotorized use in the analysis area. However, this use is not expected to grow substantially; therefore, the risk to bears associated with nonmotorized use would be negligible.

Concurrent salvage harvests on DNRC-managed lands (120 acres) are not expected to remove hiding cover or construct new roads in the subunit. Additionally, no foreseeable future forest-management activities are planned on any cooperator lands in the subunit. Therefore, no cumulative effects are expected from concurrent or foreseeable future actions of other cooperators.

All alternatives fully meet the stipulations in the SVGBCA. These alternatives are expected to result in a low risk of increased bear mortality or decreased reproduction due to displacement and human-caused mortality based on:

- the retention of a high percentage of hiding cover (74.8 to 75.2 percent),
- the minor increase in open-road density (0.3 percent),
- the increase in total-road density (3.5 to 6.5 percent),
- the reduction of secure grizzly bear habitat (2.1 to 3.3 percent),
- the restrictions of firearms, and
- the availability of undisturbed habitat in the adjacent subunits.

Action Alternative D poses the greatest risk, followed by B, C, and E, respectively.

SENSITIVE SPECIES

When conducting forest-management activities, SFLMP directs DNRC to give special consideration to several "sensitive" species. These species may be sensitive to human activities, have special habitat requirements, are associated with habitats that may be altered by timber management, and/or may, if management activities result in continued adverse impacts, become listed under the Federal Endangered Species Act. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met. The following sensitive species were considered for analysis. As shown in *TABLE F-14 - STATUS OF DNRC SENSITIVE SPECIES FOR NWLO IN RELATION TO THIS PROJECT,* each sensitive species was either included in the following analysis or dropped from further analysis for various stated reasons.

TABLE F-14 - STATUS OF DNRC SENSITIVE SPECIES FOR NWLO IN RELATION TO THIS PROJECT

SPECIES	**DETERMINATION - BASIS**
Black-backed woodpecker	No further analysis conducted – No burned habitat occurs in the project area.
Coeur d'Alene salamander	No further analysis conducted – No moist talus or streamside talus habitat occurs in the project area.
Columbian sharp-tailed grouse	No further analysis conducted – No suitable grassland communities occur in the project area.
Common loon	No further analysis conducted – No lakes occur in or near the project area.
Fisher	*Included* – Potential fisher habitat occurs in the project area.
Flammulated owl	No further analysis conducted – No dry ponderosa pine or dry Douglas-fir habitats occur in the project area.
Harlequin duck	No further analysis conducted – No observations of harlequin ducks have been documented on any streams in the project area and no alternative would alter vegetation directly adjacent to the streams in the project area.
Northern bog lemming	No further analysis conducted – No sphagnum bogs or other fen/moss mats occur in the area.
Peregrine falcon	No further analysis conducted – No potential habitat is expected in the project area.
Pileated woodpecker	*Included* – Western larch/Douglas-fir and mixed-conifer habitats occur in the area.
Townsend's big-eared bat	No further analysis conducted – No caves or mine tunnels occur in the project area.

- **Fisher**

Issue

Timber harvesting could reduce fisher habitat availability and quality by reducing canopy cover, snag density, and the amount of coarse woody debris. Reductions in fisher habitat quantity and quality could result in adverse effects to fishers.

Issue

Timber harvesting could remove canopy cover, which may impede fisher movement within their home range, resulting in decreased ability for fishers to use the analysis area.

Existing Condition

Fisher habitat consists of foraging, denning, and resting components. Fishers avoid areas with deep soft snow (*Buskirk and Powell 1994*) and are typically found below 6,000 feet in elevation (*Powell and Zielinski 1994*). Fishers are generalist predators that prey upon a variety of small mammals and birds, along with snowshoe hares and porcupines. They also take advantage of carrion and seasonally available fruits and berries (*Foresman 2001*). Fishers use a variety of successional stages, but are disproportionately found in stands with dense canopies (*Powell 1982, Johnson 1984, Jones 1991, Heinemeyer and Jones 1994*) and avoid openings or young forested stands (*Buskirk and Powell 1994*). However, some use of openings does occur for short hunting forays or if sufficient overhead cover (shrubs, saplings) is present. Fishers appear to be highly selective of stands that contain resting and denning sites (*Jones 1991*). Resting and denning sites are found in cavities of live trees and snags, downed logs, brush piles, mistletoe brooms, squirrel and raptor nests, and holes in the ground.

For cumulative effects analysis purposes, the South Fork Lost Soup Grizzly Bear Subunit scale was used (*ARM 36.11.440*). This scale includes enough area to approximate overlapping home ranges of male and female fishers (*Heinemeyer and Jones 1994*). The existing condition as it relates to fisher habitat is primarily affected by the lack of wildfire and the effects of past timber harvests. The project area and the higher elevations of the subunit consist of large patches of mature to old-growth stands that developed over time in the absence of recent stand-replacing fires. Additionally, past harvest units reduced stand age and canopy cover near the South Fork Lost Creek and Soup Creek roads and natural openings (avalanche chutes, talus slopes, etc.) near the divide between Swan Valley and the Bob Marshall Wilderness Area. The lower elevations of the subunit are a patchwork of past harvest units and natural openings with low amounts of canopy closure. Forested cover is primarily intact along Soup, Unnamed, Cilly, and South Fork Lost creeks and along the major ridges in the analysis area, resulting in highly connected forested stands, especially along the riparian corridors and across third-order drainages (South Fork Lost and Soup creeks).

To assess potential fisher habitat and travel cover on DNRC-managed lands in the analysis area, sawtimber stands within preferred fisher covertypes (*ARM 36.11.403 (60)*) below 6,000 feet in elevation with 40-percent or greater canopy closure (*Jones 1991*) were considered potential fisher habitat. Fisher habitat was further divided into upland and riparian-associated areas. In the uplands, DNRC-managed lands in the analysis area consist of approximately 9,991 acres of potential fisher habitat (*FIGURE*

F-8 - EXISTING DISTRIBUTION OF FISHER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS.

Fisher habitat in and near riparian areas tend to be used disproportionally more than their availability on the landscape (*Jones 1991*). DNRC manages preferred fisher covertypes within 100 feet of class 1 and 50 feet of class 2 streams, so that 75 percent of the acreage (State school trust lands only) would be in the sawtimber size class in moderate to well-stocked density (*ARM 36.11.440(1)(b)(i)*). Moderate (40- to 69-percent canopy closure) and well-stocked (greater than 70-percent canopy closure) density designations are based on SLI data. To ensure compliance, the number of moderately to well-stocked acres of sawtimber in preferred covertypes along streams was divided by the total acres of preferred covertypes in the same area. At the South Fork Lost Soup Subunit level, 86.9 percent of the DNRC-managed acreage associated with riparian features currently supports moderate- to well-stocked densities of sawtimber (*TABLE F-15 – ACREAGE AND PERCENT OF PREFERRED FISHER COVERTYPES CONSISTING OF SAWTIMBER STANDS PROVIDING GREATER THAN 40-PERCENT CANOPY COVER IN THE ANALYSIS AREA)*.

Predicted Effects to Fisher

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Fishers***

  Fisher habitat, preferred covertype stocking, and connectivity would remain relatively unchanged in the short term. Fisher habitat would remain at 9,991 acres (77.2 percent) in the uplands and 731 acres (86.9 percent) associated with the riparian areas on DNRC-managed lands within the cumulative-effects analysis area. The current level of connectivity would be retained. In the longer term, fisher habitat and the percentage of fisher habitat in the uplands and associated with riparian areas would increase as stands develop more overhead cover; resting/denning structure would develop as trees increase in size, die, and fall to the ground. This alternative would result in negligible effects to fishers.

- ***Direct and Indirect Effects of Action Alternative B, C, D, and E to Fishers***

  Each alternative would harvest in potential fisher habitat. Within each harvest unit, leave trees, at least 2 large snags, and 5 to 20 tons of coarse woody debris, and 1 slash pile per unit would be retained. In seedtree-with-reserve units, a number of unharvested patches of approximately 1.7 TO 4 acres would be retained so that no

TABLE F-15 - ACREAGE AND PERCENT OF PREFERRED FISHER COVERTYPES CONSISTING OF SAWTIMBER STANDS PROVIDING GREATER THAN 40-PERCENT CANOPY COVER IN THE ANALYSIS AREA.

HABITAT ELEMENT	SOUTH FORK LOST SOUP SUBUNIT
Potential habitat (% preferred upland covertypes)	9,991 acres (77.2%)
Preferred covertypes (% preferred covertypes associated with stream)	731 acres (86.9%)
Total fisher habitat *(% of preferred covertypes)*	10,722 acres (70.5%)

point of the unit exceeds 600 feet to cover. In Section 22, where regeneration harvesting occurs on both sides of South Fork Lost, Cilly, Soup, and Unnamed creeks (*FIGURE F-2 [through F-5] - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE B [C, D, AND E], WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*), a 150-foot buffer on either side of the stream would be retained. No harvesting would occur within 25 feet of the creek. From 25 to 150 feet, harvesting would remove up to 50 percent of the trees 8-inches dbh or larger, but a minimum of 40-percent canopy cover would be retained. In other areas where harvesting would occur on 1 side of said streams, a 100-foot buffer would be used. The same mitigations would apply within this buffer. The retention of 40-percent canopy cover within these buffers would retain adequate canopy cover for fishers to use as habitat or travel cover; as a result forest connectivity along the stream would be retained .

The harvesting proposed under all alternatives would result in reduced quantity and quality of fisher habitat by 1,760 to 1,924 acres, depending on whether an action alternative were chosen, and which one (*TABLE F-16 - CHANGES IN FISHER HABITAT UNDER EACH ACTION ALTERNATIVE*). In the seedtree, seedtree-with-reserves, and shelterwood harvest units, timber harvesting would reduce canopy closure to less than 40 percent and remove understory vegetation to provide for seedling establishment. Since fishers avoid stands with less than 40-percent canopy closure (*Jones 1991*) and areas that lack overhead cover (*Buskirk and Powell 1994*), these silvicultural prescriptions would result in a loss of habitat for 10 to 20 years. After this time, regeneration of conifer trees is expected to provide overhead cover, which would allow for fisher use. Retention of snag-recruitment trees and a minimum of 2 large snags per acre could provide denning or resting sites between the time the stands develop overhead cover and when the stands regenerate to a point of starting to produce large snags again. As stand matures in 80 to 100 years, canopy cover and additional structure in the form of large trees, snags, and coarse woody debris would reestablish. Conversely, commercial-thin units and areas within riparian buffers (including preferred covertypes) would retain a minimum of 40-percent canopy cover and would continue to be available for potential fisher habitat. Reductions in snag densities and coarse woody debris would occur, resulting in a potential decrease in habitat quality for fishers by removing denning/ resting structure and prey habitat. However, mitigation

TABLE F-16 - CHANGES IN FISHER HABITAT UNDER EACH ACTION ALTERNATIVE

FISHER HABITAT	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Acres of upland habitat removed	0	1,274	1,218	1,279	1,185
Acres of upland habitat altered	0	527	487	508	648
Acres of riparian habitat altered	0	83	55	84	91
Total acres of habitat affected		*1,884*	*1,760*	*1,871*	*1,924*

measures would include retention of estimated average historic levels of large snags and coarse woody debris; thereby, necessary habitat components would likely be retained, albeit at lower levels, to provide for fisher. The length of time these reductions would last depends upon the growth rate of the retention trees and resting/ denning habitat development (snags and coarse woody debris). Therefore, seedtree, seedtree-with-reserves, and shelterwood units would result in decreased habitat availability for 10 to 20 years, while commercial-thin units and stream buffers would retain usable habitat, albeit of lesser quality, following harvesting. All action alternatives pose a moderate risk of preventing or reducing habitat use in the harvest units, which would result in habitat shifts away from these areas and increased use of other stands in the analysis area.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Fishers***

  Available fisher habitat would be reduced within the cumulative-effects analysis area. On DNRC-managed lands, available fisher habitat in the uplands would decline from 9,991 acres to between 8,712 and 8,806 acres (a 11.9- to 12.8-percent reduction in habitat). Additionally, habitat quality would be reduced on between 487 and 648 acres (4.9 to 6.5 percent of existing habitat). No losses in the amount of fisher habitat associated with streams would occur, but 55 to 91 acres of habitat associated with riparian areas would be reduced in quality through timber harvesting. Additionally, connectivity would be maintained along the streams, ridges, and across third-order drainages (*ARM 36.11.441[1][c]*). On adjacent ownerships, an additional 6,452 acres of fisher habitat could be present, thereby, adding to the amount of fisher habitat in the analysis area. The reduction in fisher habitat is expected to result in avoidance of the seedtree harvest units, but, since the remaining portions of fisher habitat on DNRC-managed lands provide high densities of snags and coarse woody debris, the risk of these alternatives reducing the quantity or quality of fisher habitat to the point where fishers can no longer use the analysis area is low. Other activities that could lead to additional impacts on fisher habitat include concurrent or future timber or salvage harvesting and public firewood cutting. DNRC is concurrently considering salvage harvests on an additional 120 acres in the analysis area. These harvests would not affect the quantity, but could reduce the quality of fisher habitat. No fisher habitat is expected to be harvested from adjacent lands during the 2007 through 2009 period. Firewood cutting would be limited to areas near open roads. Due to the small area affected by these additional activities, any additional changes in fisher habitat are expected to be minor.

Considered in conjunction with other past, present, and future activities, any proposed action alternative would likely result in a low risk of cumulative effects to fishers. *TABLE F-17 - PREDICTED POSTHARVEST FISHER HABITAT UNDER EACH ACTION ALTERNATIVE WITHIN THE CUMULATIVE-EFFECTS ANALYSIS AREA* summarizes the effects to fisher habitat.

TABLE F-17 - PREDICTED POSTHARVEST FISHER HABITAT UNDER EACH ACTION ALTERNATIVE WITHIN THE CUMULATIVE-EFFECTS ANALYSIS AREA

FISHER HABITAT			ACRES OF RETAINED HABITAT (% REDUCTION) (% PREFERRED COVERTYPE*)	ACRES OF REDUCED QUALITY (% REDUCTION) (% PREFERRED COVERTYPE*)
Alternative	A	Upland habitat	9,991 (0.0%) (77.2%)	0 (0.0%) (0.0%)
		Riparian habitat	731 (0.0%) (86.9%)	0 (0.0%) (0.0%)
	B	Upland habitat	8,717 (12.8%) (67.4%)	527 (5.3%) (4.1%)
		Riparian habitat	731 (0.0%) (86.9%)	83 (11.4%) (9.9%)
	C	Upland habitat	8,773 (12.2%) (67.8%)	487 (4.9%) (4.1%)
		Riparian habitat	731 (0.0%) (86.9%)	55 (7.5%) (6.5%)
	D	Upland habitat	8,712 (12.8%) (67.3%)	508 (5.1%) (4.1%)
		Riparian habitat	731 (0.0%) (86.9%)	84 (11.5%) (10.0%)
	E	Upland habitat	8,806 (11.9%) (68.0%)	648 (6.5%) (4.1%)
		Riparian habitat	731 (0.0%) (86.9%)	91 (12.5%) (10.8%)

**Percent preferred covertype is the percentage of preferred covertype in the sawtimber size class with greater than 40-percent canopy cover divided by all acres of lands within these covertypes.*

- **Pileated Woodpecker**

Issue

Timber harvesting could cut nest trees or displace adults away from active nests, resulting in increased mortality of pileated woodpecker chicks.

Dismissed

Under all action alternatives, timber harvesting could result in direct mortality of nestlings if nest trees were cut prior to the nestlings' fledging or if the adults are displaced from the nest area. A majority of harvesting would occur after June 15 due to stipulations in the SVGBCA (ie., would occur outside the spring grizzly bear season) or would be delayed due to soil moisture conditions, and nest trees would likely be marked to leave. Therefore, most harvesting activities would occur after pileated woodpecker nestlings have fledged (*Bull and Jackson 1995*), and, if they occurred during the nesting period, the nest tree would likely be retained.

Issue

Timber harvesting would remove canopy cover and snags needed by pileated woodpeckers to forage and nest. The reduction of habitat could lead to a reduced ability for pileated woodpeckers to use and/or reproduce in the area.

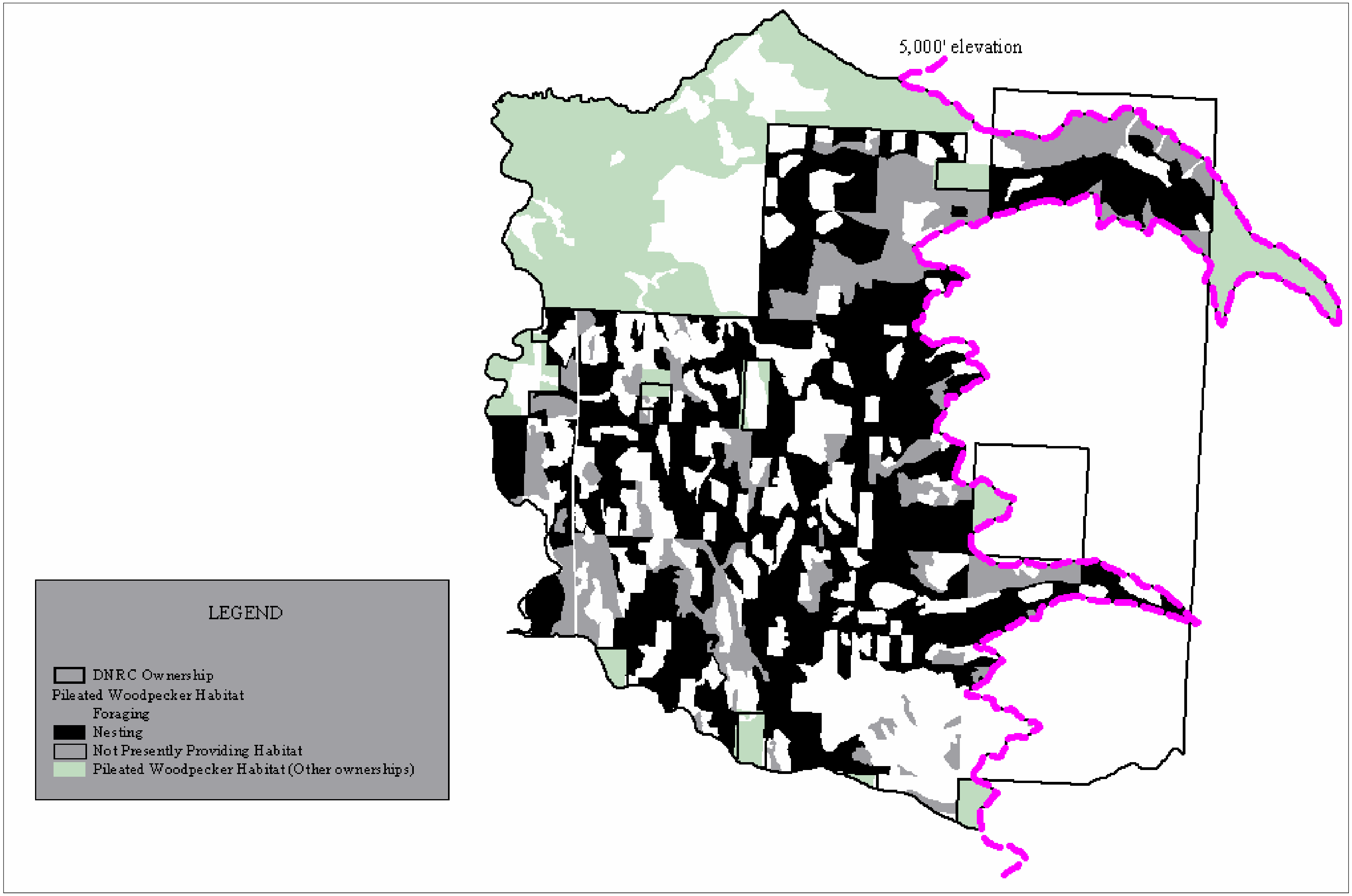
Existing Condition

Pileated woodpeckers play an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals. Pileated woodpeckers excavate the largest cavities of any woodpecker. Preferred nest trees are western larch, ponderosa pine, cottonwood, and quaking aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated nesting habitat as...“stands of 50 to 100 contiguous acres, generally below 5,000 feet in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy.” The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and downed wood for feeding, closely tie these woodpeckers to mature forests with late-successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*).

Pileated woodpecker habitat is comprised of nesting and foraging habitats. Pileated woodpecker nesting habitat was identified by searching the SLI database for stands over 100 years old and with more than 100 square feet basal area per acre, more than 40 percent canopy cover, and below 5,000 feet in elevation. Foraging habitat does not include the acres that meet the definition above, but includes the remaining sawtimber stands below 5,000 feet in elevation with greater than 40-percent canopy cover. To assess habitat on other ownerships in the cumulative-effects area, aerial photographs were interpreted to assess forest stands under 5,000 feet in elevation. Where stands appeared to meet the minimum potential foraging habitat, pileated woodpecker habitat was assumed present. Potential foraging and nesting habitat were not differentiated on other ownerships for this analysis due to data limitations.

The South Fork Lost Soup Grizzly Bear Subunit provided the analysis area to consider the effects to pileated woodpeckers. Since the project area occurs toward the upper elevations used by pileated woodpeckers and extends across 3 major drainages, the subunit analysis area was chosen to better reflect the potential pileated woodpecker home ranges that are contained within each drainage. A majority (73 percent) of this area is managed by DNRC, with adjacent lands also providing potential habitat. On DNRC-managed lands, 6,130 acres of nesting and 2,305 acres of foraging habitats currently exist. Although nesting habitat is defined differently than foraging habitat, nesting habitat also provides foraging opportunities for pileated woodpeckers. On adjacent ownerships, approximately 3,411 acres of habitat could occur. When combined, SLI modeling and the interpretation of aerial photographs for other than DNRC-managed lands indicated that approximately 11,846 acres of potential pileated woodpecker habitat are in the analysis area (*FIGURE F-9 - EXISTING DISTRIBUTION OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS*). However, no population estimate for the area is available.

FIGURE F-9 - EXISTING DISTRIBUTION OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS



Predicted Effects to Pileated Woodpeckers

- ***Direct and Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  No disturbance of pileated woodpeckers would occur. Forest succession and natural disturbance agents would continue to bring about changes in existing stands. Trees would continue to grow, mature, and die, thus providing potential nesting and foraging structure for pileated woodpeckers. However, as shade-intolerant trees die and fall to the ground, barring any sizable disturbances that would promote the reestablishment of shade-intolerant tree species, preferred nesting trees (shade-intolerant) and snags could become rare. Thereby, nesting habitat structure would decline and could lead to decreased reproduction in the analysis area. Therefore, under this alternative, pileated woodpecker habitat would increase through time, then decline, resulting in a short- to mid-term moderate beneficial effect to pileated woodpeckers, but a long-term moderate negative effect due to the declining densities in quality nesting-habitat structure (western larch trees and snags).

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Pileated Woodpeckers***

  Under all action alternatives, between 1,051 and 1,559 acres of potential nesting habitat, plus an additional 140 to 394 acres of potential foraging habitat, would be modified (*TABLE F-18 - CHANGES IN PILEATED WOODPECKER HABITAT UNDER EACH ACTION ALTERNATIVE*). Where harvests reduce canopy cover to less than 40 percent, potential pileated habitat (nesting and foraging) would be removed for 30 to 100 years, depending on the density of trees retained. Where harvest retain more than 40-percent canopy cover, pileated woodpecker habitat would likely retain a minimum of 40-percent canopy cover, but the number of snags could be reduced substantially. However, 2 large snags per acre would be retained to approximate the average historic abundance of snags; therefore, adequate nesting and foraging structure would likely be retained, albeit reduced from current conditions. Since pileated woodpecker density is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*), pileated woodpecker densities in the analysis area could be expected to be reduced by all alternatives. In the longer term, seral species would be planted under this alternative and could provide pileated woodpecker habitat in the distant future (100 to 150 years).

TABLE F-18 - CHANGES IN PILEATED WOODPECKER HABITAT UNDER EACH ACTION ALTERNATIVE

PILEATED WOODPECKER HABITAT	**ALTERNATIVE**				
	A	B	C	D	E
Acres of nesting habitat removed	0	950	1,104	731	806
Acres of nesting habitat altered	0	448	455	320	344
Acres of foraging habitat removed	0	255	121	253	176
Acres of foraging habitat altered	0	48	19	104	218
Total acres of habitat affected	*0*	*1,701*	*1,699*	*1,408*	*1,544*

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

  No projects are planned on adjacent ownerships; therefore, the amount of habitat on these lands is expected to be retained, while, over time, shade-intolerant tree species would become rare on adjacent lands. In combination with the effects expected under this alternative, nesting habitat structure could become rare on all lands in the analysis area, resulting in a moderate risk of reduced reproduction in the analysis area.

  On DNRC-managed lands, salvage harvests are planned for 120 acres of nesting habitat in the analysis area. These salvage harvests remove dead and dying trees that could provide foraging and nesting structure and generally do not facilitate regeneration of shade-intolerant tree species for future habitat structure. Following harvesting, these acres would still qualify as nesting habitat because large snags and adequate canopy closure would be retained, albeit reduced. Thereby, these activities could result in both short-term and long-term reduction in habitat quality, but at a small scale, resulting in a low risk of additional effects to pileated use and reproduction in the analysis area.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Pileated Woodpeckers***

  Potential habitat would be reduced to between 6,734 acres and 7,027 (a 16.7- to 20.1-percent reduction from the existing 8,435 acres) on DNRC-managed lands in the cumulative effects analysis area (*TABLE F-19 - ACREAGE OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LAND AS A RESULT OF EACH ALTERNATIVE*). The proposed harvests would remove large patches of potential habitat while retaining a majority of the existing habitat (between 79.9 and 83.3 percent) in the analysis area. Although potential habitat would be reduced under this alternative, the remaining habitat consists of high densities of snags that provide forage and nesting

TABLE F-19 - ACREAGE OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LAND AS A RESULT OF EACH ALTERNATIVE

PILEATED WOODPECKER HABITAT	ALTERNATIVE				
	A	B	C	D	E
Acres of retained nesting habitat (% reduction)	6,130 (0.0%)	5,180 (15.5%)	5,026 (18.0%)	5,399 (11.9%)	5,264 (14.2%)
Acres of reduced quality nesting habitat (% reduction)	0 (0.0%)	448 (7.3%)	455 (7.4%)	320 (5.2%)	344 (5.6%)
Acres of retained foraging habitat (% reduction)	2,305 (0.0%)	2,050 (11.1%)	2,148 (5.3%)	2,052 (11.0%)	2,129 (7.6%)
Acres of reduced quality foraging habitat (% reduction)	0 (0.0%)	48 (2.1%)	19 (0.1%)	104 (4.5%)	218 (9.5%)
Total acres of pileated woodpecker habitat (% reduction)	8,435 0.0%	6,734 20.2%	6,736 20.1%	7,027 16.7%	6,891 18.3%

structure, which could offset some of the losses experienced in the harvest units. Additionally, estimated historic densities of large snags (2 snags per acre) would be retained within the harvest units to provide foraging and nesting structure when the canopy closure recovers to the point of allowing pileated woodpecker use. In addition, approximately 3,411 acres of potential pileated woodpecker habitat exists on the adjacent lands. In the long-term (100 to 150 years), these stands are expected to regenerate with a major proportion of western larch, which could provide nesting and feeding structural components in the future, thereby improving pileated woodpecker habitat. Each alternative is expected to remove between 11.9 and 18.0 percent of the existing nesting habitat, while reducing quality on an additional 5.2 to 7.3 percent of the available habitat. Foraging habitat would be less affected (*TABLE F-19 - ACREAGE OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LAND AS A RESULT OF EACH ALTERNATIVE*). However, the reduction in nesting habitat would reduce nesting and foraging habitat structure available to pileated woodpeckers, which could result in a moderate risk of reducing the use and reproduction of pileated woodpeckers in the analysis area in the short term. These effects could be lessened to some degree due to the high density of snags found in the project area. In 80 to 100 years, each alternative would likely contribute to the potential for nesting structure in the analysis area by regenerating preferred nest trees (western larch).

Other activities in the area could reduce habitat quality, but no changes in quantity are expected. DNRC is concurrently considering salvage harvests on an additional 120 acres of nesting habitat in the area. Following harvesting, these acres would still qualify as nesting habitat because large snags and adequate canopy closure would be retained. No other forest-management projects are expected to occur in the analysis area during the active period of 2007 through 2009. Firewood cutting would likely continue to remove dead and dying trees primarily along open roads on all lands in the South Fork Lost Soup Subunit. None of these activities would substantially add to the effects expected under each alternative. Considered in conjunction with other past, present, and future activities, any of the proposed action alternatives would result in low risk of cumulative effects to pileated woodpecker.

BIG GAME

Issue

Timber harvesting could reduce thermal cover on big game winter ranges. Reductions in thermal cover could result in a reduced carrying capacity of the winter range.

Existing Condition

When considering populations of big game species, the winter-range component of their habitat is usually the limiting factor driving big game populations. During the winter period, plant dormancy results in decreased forage quality, while snow cover limits forage quantity and increases the energetic costs of maintaining body heat in a cold environment and movement through snow. To increase access to forage and decrease energetic costs, big game species seek areas with low snow cover and higher temperatures, which are typically found on south to west aspects. In addition, big

game species seek vegetative cover to fulfill these same needs. Forest cover intercepts snow, which increases an animal's ability to find forage, while reducing the energetic costs of movement and ameliorating the effects of weather. Forested stands that fulfill these needs are referred to as thermal cover.

Thermal cover is defined for elk as stands with trees greater than 40 feet tall with a crown closure of 70 percent or more (*Thomas 1979*). Stands with 40- to 70-percent canopy closure may not provide thermal cover by definition, but do provide many of the benefits related to snow interception. Since western larch loses its needles during winter, stands dominated by western larch generally do not provide much snow intercept. Therefore, for this analysis, thermal cover includes pole and sawtimber stands that are not dominated by western larch and have greater than 40-percent canopy closure.

To assess cumulative effects to big game, winter range within the South Fork Lost Soup Subunit was used. This scale of analysis provides enough area to provide winter habitat for a herd of elk. DFWP designated big game species throughout the State. In the analysis area, DFWP mapped elk (*DFWP 1999*) and mule deer (*DFWP 2004*) winter ranges, but no white-tailed deer (*DFWP 1996*) winter range. White-tailed deer winter range occurs primarily on the valley floor to the southwest of the analysis area in the Goat Creek Grizzly Bear Subunit. Changes to winter range caused by the proposed project could affect elk and mule deer winter range, but would not affect white-tailed deer. Therefore, the following analysis focuses on elk and mule deer, while not conducting any further analysis on white-tailed deer.

Since most of the winter range for elk and mule deer overlap, a composite winter range was used for analysis purposes. The composite winter range includes 6,613 acres, of which 5,434 acres occur on DNRC-managed lands and 1,179 acres occur on other ownership in the analysis area (*FIGURE F-10 - THERMAL COVER LOCATED ON DNRC-MANAGED LANDS AND ADJACENT LANDS WITHIN THE ELK-MULE DEER COMPOSITE WINTER RANGE*). Of the winter range within the State ownership in the analysis area, 3,503 acres (64.5 percent) provide thermal cover. Based on interpretation of aerial photographs, approximately 1,100 acres (93.3 percent) on adjacent lands could provide thermal cover. When the winter range is analyzed for all ownerships in the analysis area, approximately 4,603 acres (69.6 percent) of thermal cover exists. However, this estimate is likely high due to the inclusion of stands dominated by western larch, which could not be distinguished through interpretation of aerial photographs.

PREDICTED EFFECTS TO ELK AND MULE DEER

Direct and Indirect Effects

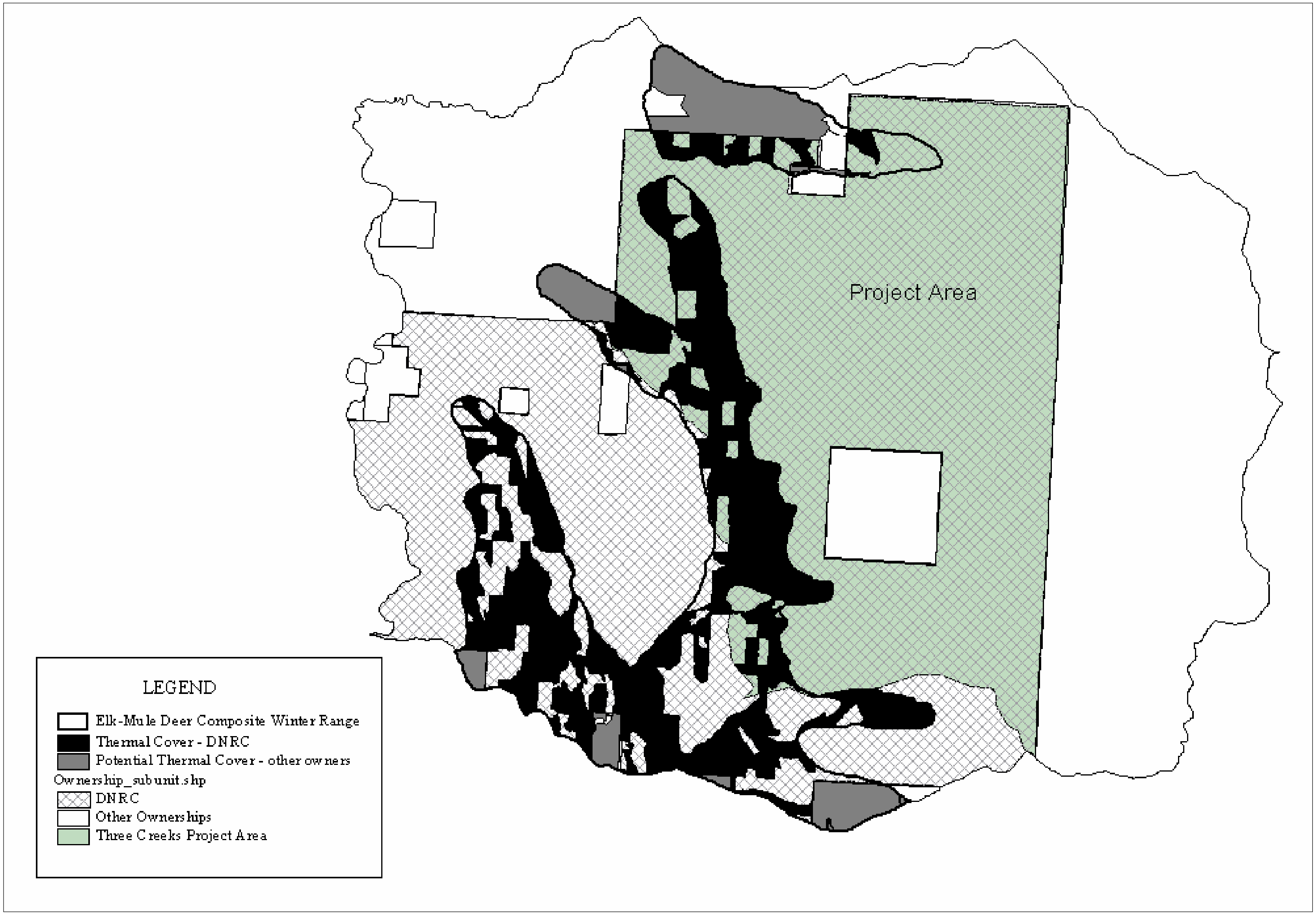
- ***Direct and Indirect Effects of No-Action Alternative A to Elk and Mule Deer***

  Thermal-cover levels would not be affected. Through time, thermal cover could be reduced by insects and diseases. However, as overstory trees die, younger shade-tolerant trees present in the understory would likely fill in the canopy gap, resulting in a short-term loss of thermal cover. Under this alternative, the ability of the available habitat to support the current elk and mule deer population would remain largely unchanged.

- ***Direct and Indirect Effects to Action Alternatives B, C, D, and E to Elk and Mule Deer***

  Each alternative proposes to harvest between 675 and 895 acres

FIGURE F-10 - THERMAL COVER LOCATED ON DNRC-MANAGED LANDS AND ADJACENT LANDS WITHIN THE ELK-MULE DEER COMPOSITE WINTER RANGE



of thermal cover. However, only regeneration harvests (seedtree and shelterwood) would reduce canopy cover to less than 40 percent, resulting in a loss of thermal cover. Therefore, the alternatives would remove between 514 and 601 acres of thermal cover. On the other harvested acreage, greater than 40-percent canopy cover would be retained, which would retain thermal cover, albeit with reduced quality from the existing condition (*TABLE F-20 - ACRES OF THERMAL COVER AFFECTED BY ALTERNATIVE*). These reductions are expected to result in a moderate risk of habitat shifts of wintering elk and deer away from treated areas. The risk of avoidance would increase in relation to greater snow accumulations in these areas.

Cumulative Effects

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Elk and Mule Deer***

  Following implementation of an action alternative, the amount of thermal cover on DNRC-managed portions of the composite winter range would range between 2,989 to 2,903 acres (a 14.7- to 17.2-percent reduction). Commercial-thin prescriptions would reduce the quality of thermal cover on another 3.1 to 8.4 percent of the existing thermal cover. The proposed harvests would reduce the percentage of winter range in thermal cover from 64.5 percent to between 53.4 and 55.0 percent on DNRC-managed lands (*TABLE F-21 - ACRES OF THERMAL COVER RESULTING FROM THE IMPLEMENTATION OF EACH ALTERNATIVE*). Concurrent salvage harvests on DNRC-managed lands (120 acres) within the winter range are not expected to alter thermal cover and, therefore, would not increase the risk of reducing carrying capacity on this portion of the winter range. On DNRC-managed lands, enough thermal cover would be retained under any alternative to provide adequate winter range habitat for elk and mule deer; therefore, a low risk to the reduction of carrying capacity is expected under any alternative.

  In addition to the thermal cover found on DNRC-managed lands, an additional 1,100 acres of thermal cover could occur on adjacent ownerships within the cumulative-effects analysis area. When these acres are considered, the action alternatives would reduce the proportion of thermal cover on the composite winter range from 69.6 percent to between 60.5 and 61.8 percent. No additional forest-management activities are expected on adjacent lands during the 2007 through 2009 active period. Therefore, this thermal cover would remain available to winter animals, thereby reducing the overall effects of any alternative. However, the use of harvested areas is expected to be reduced when snow accumulations increase. Considered in conjunction with other past, present, and future activities, any of the proposed action alternatives would result in low risk of substantially reducing the carrying capacity of elk and mule deer in the analysis area.

TABLE F-20 - ACRES OF THERMAL COVER AFFECTED BY ALTERNATIVE

THERMAL COVER	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Acres removed	0	542	600	514	601
Acres reduced in quality	0	149	109	161	294
Total acres of habitat affected	*0*	*691*	*709*	*675*	*895*

TABLE F-21 - ACRES OF THERMAL COVER RESULTING FROM THE IMPLEMENTATION OF EACH ALTERNATIVE

THERMAL COVER	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Acres of retained	3,503	2,961	2,903	2,989	2,904
(% reduction)	(0.0%)	(15.5%)	(17.1%)	(14.7%)	(17.2%)
(% of winter range on DNRC)	(0.0%)	(54.5%)	(53.4%)	(55.0%)	(53.4%)
Acres of reduced quality	0	149	109	161	294
(% reduction)	(0.0%)	(4.3%)	(3.1%)	(4.6%)	(8.4%)
(% of winter range on DNRC)	(64.5%)	(2.7%)	(2.0%)	(3.0%)	(5.4%)
Total acres affected	0	691	709	675	895
(% of winter range on DNRC)	(0.0%)	(19.7%)	(20.2%)	(19.3%)	(25.5%)
(% affected)	(64.5%)	12.7%)	(13.0%)	(12.4%)	(16.5%)

APPENDIX G
SOILS ANALYSIS

INTRODUCTION

The Swan River watershed is a valley formed by glaciers and river processes. The dominant soil types found in the project area are deep glacial tills derived from argillite, siltite, and limestone from the Belt Supergroup. Upper slopes and ridges are weathered bedrock scoured by glaciers. This analysis addresses the issue that timber harvesting and associated activities may affect soil conditions in the proposed project area.

ANALYSIS METHODS

Soil effects and conditions will be analyzed by evaluating the current levels of soil disturbance in the proposed project area through the use of aerial-photo interpretation and ocular estimates based on field review of existing and proposed harvest units. Analysis will also include assessing slope stability with aerial-photo interpretation and field review of proposed roads and harvest units.

Estimated effects of proposed activities will be assessed based on findings of DNRC soil monitoring. Soil-monitoring efforts have been ongoing by DNRC over the last 20 years. Through soil monitoring conducted in Swan River State Forest on soil types similar to those found in the proposed project area, DNRC found that ground-based skidding on slopes of 0 to 15 percent on the Goat Creek watershed resulted in 13.8 percent of the area in detrimental soil effects, with no observed soil erosion. Ground-based skidding on slopes of 20 to 50 percent in the Woodward Creek watershed in 2002 resulted in 8.1 percent of the area in detrimental soil effects, and spotty soil erosion was observed on segments of skid trails (*DNRC 2004*). Based on analysis in the SFLMP, analysis found that up to 20 percent of ground-based harvest areas would be trafficked by skid trails (*DNRC 1996*), and DNRC soils monitoring has shown that up to an estimated 75 percent of the skid trails would result in moderate to severe impacts. In addition, DNRC conducted soil monitoring in 2002 on cable-yarding units in a burned area. The results of this monitoring are found in the *MOOSE PROJECT SOIL MONITORING REPORT (DNRC 2003)*. Results found that up to 5 percent of cable yarding units were in an impacted condition.

TABLE OF CONTENTS

Introduction G-1
Analysis Methods G-1
Analysis Area G-1
Existing Conditions G-1
Alternative Effects G-2

ANALYSIS AREA

The analysis area for evaluating soil effects will include State-owned land within the Three Creeks Timber Sale Project area. The proposed project area is found within the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds.

EXISTING CONDITIONS

Soil types in the project area include deep alluvial and glacial deposits on the nearly level valley floor with wetland types in the lower portions of Cilly Creek and Soup Creek. The valley sideslopes have moderate to deep glacial till deposits with cobbly silt loam subsoils and, in most cases, a volcanic ash surface soil. Shallow bedrock and high-rock-content residual soils are found on glacial scoured ridges. A list of soil types found in the Three Creeks Timber Sale Project area and their

associated management implications is found in *TABLE G-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE THREE CREEKS PROJECT AREA*. The *FNF Soil Survey* identified one area of soils at elevated risk for mass movements in the project area. This soil type is landtype 77, and is found in the southern portion of the proposed project area south of Soup Creek. During field reconnaissance, several areas of past slope instability were identified in the proposed project area. These areas, mostly small, are a result of several site-specific conditions. These conditions include a combination of the glacial till, steep slopes, shallow depth to bedrock, and avalanche chutes; in one case, past management may have been a contributing factor. A more detailed description of past slope instability and recommended measures to mitigate for possible instability can be found in the project file at Swan River State Forest.

The proposed project area is approximately 10,344 acres and is located in Swan River State Forest. In the proposed project area, DNRC has conducted timber harvesting since the 1950s. Based on review of aerial photos from the 1960s through the present, section record cards, and timber sale records, approximately 1,463 acres (or about 14 percent of the acres in the project area) have been harvested on State land within the proposed project area using a combination of ground-based and cable-yarding harvest methods. Ground-based yarding can affect soil conditions through displacement and compaction of productive surface layers of soil, mainly on heavily used trails. Cable yarding can also produce impacts to soils. These impacts mainly occur where one end of the logs are dragged on the ground as logs are lifted to the landing, especially on convex slopes where the cable line may be closer to the ground and logs are not lifted as high. These impacts are generally far less in area and degree of impact than impacts from ground-based skidding.

Based on field review of past harvest areas within the proposed project area, existing soils impacts are estimated to be 10 percent or less of the previously harvested areas. Field reconnaissance using ocular estimates shows that existing skid trails are spaced about 50 to 60 feet apart, and take up approximately 15 percent of the harvested areas. Many of the existing trails from past management are well vegetated, and past impacts are ameliorating from frost and vegetation growth. Frost and vegetation are estimated to have reduced old impacts by about one-third of their original levels leaving approximately 10 percent impacts to soils in previously harvested areas. Soil impact observations in the proposed project area are similar to levels found in DNRC soil monitoring in and around the Swan River State Forest. Minimal evidence of isolated soils erosion was observed on short pitches of existing skid trails and landings within the project area.

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A to Soils***

  Direct or indirect impacts would not occur with this alternative. No ground- or cable-based activity would take place under this alternative, which would leave the soil in the project area unchanged from the description in *EXISTING CONDITIONS* of this analysis. Existing areas of slope instability or erosion would continue to recover or degrade according to natural and preexisting conditions and would not be affected by this alternative.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Soils***

The estimated range of soil impacts for all action alternatives is from 7 to 9 percent of all harvested acres, and no individual harvest unit is expected to have impacts greater than 15 percent. Fifteen percent impacts fall within the range of impacts analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP (DNRC 1996)*. According to the SFLMP, the level of concern for compaction and displacement is elevated when these impacts exceed 20 percent of an area (*DNRC 1996)*. DNRC expects that by maintaining 85 percent of the area with healthy soil conditions and limiting the detrimental effects of moderate and severe displacement, compaction, and erosion to less than 15 percent of the area, productive and hydrologically stable sites will be maintained within harvested areas. This level of impacts would be achieved through a combination of skidding mitigation measures including, but not limited to:

- slope and equipment restrictions;
- restriction for season-of-use to periods of dry, frozen, or snow-covered soil conditions;
- utilization of a minimum skid-trail spacing;
- installation of erosion control where needed;
- retention of 10 to 15 tons per acre of woody debris; and
- adherence to all applicable BMPs.

Proposed timber-harvesting and road-building operations in all action alternatives are not expected to increase mass soil movements in the analysis area. Risk of slope failure could increase in some stands following the removal of live trees, but slope failure risk would decrease in other areas due to mitigation measures designed to protect and improve slope stability risk. Mitigation measures to maintain slope stability include:

- removal of trees with mortality risk, windthrow risk, and thinning of overstocked stands;
- promote actively growing codominant trees;
- use cable and helicopter yarding on steep slopes;
- avoid road construction across slopes with marginal stability; and
- upgrade the existing road system with BMPs, adequate surface drainage and erosion control to eliminate concentration of runoff.

A more detailed assessment of the impacts of the proposed action alternatives on slope stability can be found in the project file at the Swan River State Forest office.

Timber-harvesting operations in all action alternatives would retain adequate coarse woody debris (greater than 3 inches in diameter) and green litter to conserve available nutrients and maintain long-term soil conditions similar to the range of natural conditions. To be effective, the material would be well distributed across the management unit. Current direction for recommended amounts of debris to retain during operations would be based on *"Managing Coarse Woody Debris in Forests of the Rocky Mountains" (Graham et al. 1994)* and ranges from 4 to 33 tons per acre based on habitat types. As more information on the role of woody debris and litter is developed concerning tree growth and site productivity, DNRC may modify the recommendations. On sites where levels of coarse woody debris are below average historic levels (compared to *Graham et al 1994*), proposed silvicultural

prescriptions would be designed to promote larger tree diameters for future coarse woody debris through snag management (*ARM 36.11.411*).

- ***Direct and Indirect effects of Action Alternative B to Soils***

BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 8.7 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed in the *ANALYSIS METHODS* portion of this analysis. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 891 acres, cable yarding on approximately 557 acres, and landings from helicopter yarding.

Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 – SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative B. These activities would leave up to 8.7 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

- ***Direct and Indirect Effects of Action Alternative C to Soils***

BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 8.6 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed under *ANALYSIS METHODS*. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 823 acres, cable yarding on approximately 543 acres, and landings from helicopter yarding.

Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 – SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative C. These activities would leave up to 8.6 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

- ***Direct and Indirect Effects of Action Alternative D to Soils***

  BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 7.2 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed under *ANALYSIS METHODS*. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 699 acres, cable yarding on approximately 679 acres, and landings from helicopter yarding.

  Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 – SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative D. These activities would leave up to 7.2 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

- ***Direct and Indirect Effects of Action Alternative E to Soils***

  BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 7.6 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed in the *ANALYSIS METHODS* portion of this analysis. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 786 acres, cable yarding on approximately 629 acres, and landings from helicopter yarding.

  Ground-based site preparation and road construction would also

TABLE G-1 – SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING

DESCRIPTION OF PARAMETER	**ALTERNATIVE**				
	A	**B**	**C**	**D**	**E**
Acres of harvest	0	1,856	1,752	1,941	1,966
Acres of helicopter yarding	0	408	386	563	551
Acres of tractor yarding	0	891	823	699	786
Acres of skid trails and landings[1]	0	178	165	140	157
Acres of cable yarding	0	557	543	679	629
Acres of yarding corridors[2]	0	56	54	68	63
Acres of moderate impacts[3]	0	162	151	139	149
Percent of harvest area with impacts	0%	8.7%	8.6%	7.2%	7.6%

[1] *20 percent of ground-based area*
[2] *5 to 10 percent of cable yarding units*
[3] *75 percent of ground-based skid trails and 50 percent of cable corridors (based on DNRC monitoring as reported under ANALYSIS METHODS)*

generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 – SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative E. These activities would leave up to 7.6 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Soils***

This alternative would have no additional cumulative impacts on soil conditions. No soil would be disturbed, and no past harvest units would be entered. Previously harvested areas would continue to ameliorate over time. Cumulative effects of this alternative would be similar to those described under *EXISTING CONDITIONS* of this analysis.

- ***Cumulative Effects to Soils Common to Action Alternatives B and C***

Both of these alternatives would enter one stand (approximately 19 acres) where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand. Cumulative impacts may include compaction, displacement, and erosion on additional trails beyond those already existing from past entries. Additional compaction and displacement may occur on existing trails from reuse. Any amelioration of compaction from frost action and vegetation is erased if an existing trail is reused by equipment, and the effects may be more extensive with repeated use. DNRC would maintain healthy soil conditions and minimize adverse cumulative effects by implementing any or all of the following:

- use of existing skid trails from past harvesting activities if they are properly located and spaced;
- use of additional skid trails only where existing trails are unacceptable;
- use of soil moisture restrictions, season of operation, and method of harvesting to mitigate potential direct and indirect effects; and
- retention of 10 to 15 tons per acre of coarse woody debris and fine litter for nutrient cycling.

Based on soil monitoring conducted on DNRC land in Swan River State Forest, DNRC expects cumulative effects to soil conditions to be 15 percent or less of harvested areas, including impacts from past harvesting. In most of the proposed project area, cumulative impacts would be less than 10 percent. Each value is within or below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

In the remaining previously unharvested stands, cumulative effects to soil conditions from multiple entries would be the same as those listed under *Direct and Indirect Effects*. For slash treatment, equipment piling of slash and site preparation would be limited to less than 30-percent scarified soils within regeneration harvest units. Scarification to mix the surface duff to promote conifer

establishment, but not remove surface soil, is considered a nondetrimental effect to soils. Future stand entries would likely use existing trails and landings.

- ***Cumulative Effects of Action Alternative D to Soils***

This alternative would enter one stand (approximately 8 acres) where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand. Cumulative impacts may include compaction, displacement, and erosion on additional trails beyond those already existing from past entries. Additional compaction and displacement may occur on existing trails from reuse. Any amelioration of compaction from frost action and vegetation growth is erased if an existing trail is reused by equipment, and the effects may be more extensive with repeated use. DNRC would maintain healthy soil conditions and minimize adverse cumulative effects by implementing any or all of the following:

- use of existing skid trails from past harvesting activities if they are properly located and spaced;
- use of additional skid trails only where existing trails are unacceptable;
- use of soil moisture restrictions, season of operation, and method of harvesting to mitigate potential direct and indirect effects; and
- the retention of 10 to 15 tons per acre of coarse woody debris and fine litter for nutrient cycling.

Based on soil monitoring conducted on DNRC-managed land in Swan River State Forest, DNRC expects cumulative effects to soil conditions to be 15 percent or less of harvested areas, including impacts from past harvesting. In most of the proposed project area, cumulative impacts would be less than 10 percent. Each value is within or below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

In the remaining previously unharvested stands, cumulative effects to soil conditions from multiple entries would be the same as those listed under *DIRECT AND INDIRECT EFFECTS*. For slash treatment, equipment piling of slash and site preparation would be limited to less than 30-percent scarified soils within regeneration harvest units. Scarification to mix the surface duff to promote conifer establishment, but not remove surface soil, is considered a nondetrimental effect to soils. Future stand entries would likely use existing trails and landings.

- ***Cumulative Effects of Action Alternative E to Soils***

This alternative would enter 2 stands (combined 27 acres) where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand. Cumulative impacts may include compaction, displacement, and erosion on additional trails beyond those already existing from past entries. Additional compaction and displacement may occur on existing trails from reuse. Any amelioration of compaction from frost action and vegetation growth is erased if an existing trail is reused by equipment, and the effects may be more extensive with repeated use. DNRC would maintain healthy soil conditions and minimize adverse cumulative effects by implementing any or all of the following:

- use of existing skid trails from past harvesting activities if they are properly located and spaced;
- use of additional skid trails only where existing trails are unacceptable;
- use of soil moisture restrictions, season of operation, and method of harvesting to mitigate potential direct and indirect effects; and
- the retention of 10 to 15 tons per acre of coarse woody debris and fine litter for nutrient cycling.

Based on soil monitoring conducted on DNRC-managed land in Swan River State Forest, DNRC expects cumulative effects to soil conditions to be 15 percent or less of harvested areas, including impacts from past harvesting. In most of the proposed project area, cumulative impacts would be less than 10 percent. Each value is within or below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP*, and well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

In the remaining previously unharvested stands, cumulative effects to soil conditions from multiple entries would be the same as those listed under *DIRECT AND INDIRECT EFFECTS*. For slash treatment, equipment piling of slash and site preparation would be limited to less than 30-percent scarified soils within regeneration harvest units. Scarification to mix the surface duff to promote conifer establishment, but not remove surface soil, is considered a nondetrimental effect to soils. Future stand entries would likely use existing trails and landings.

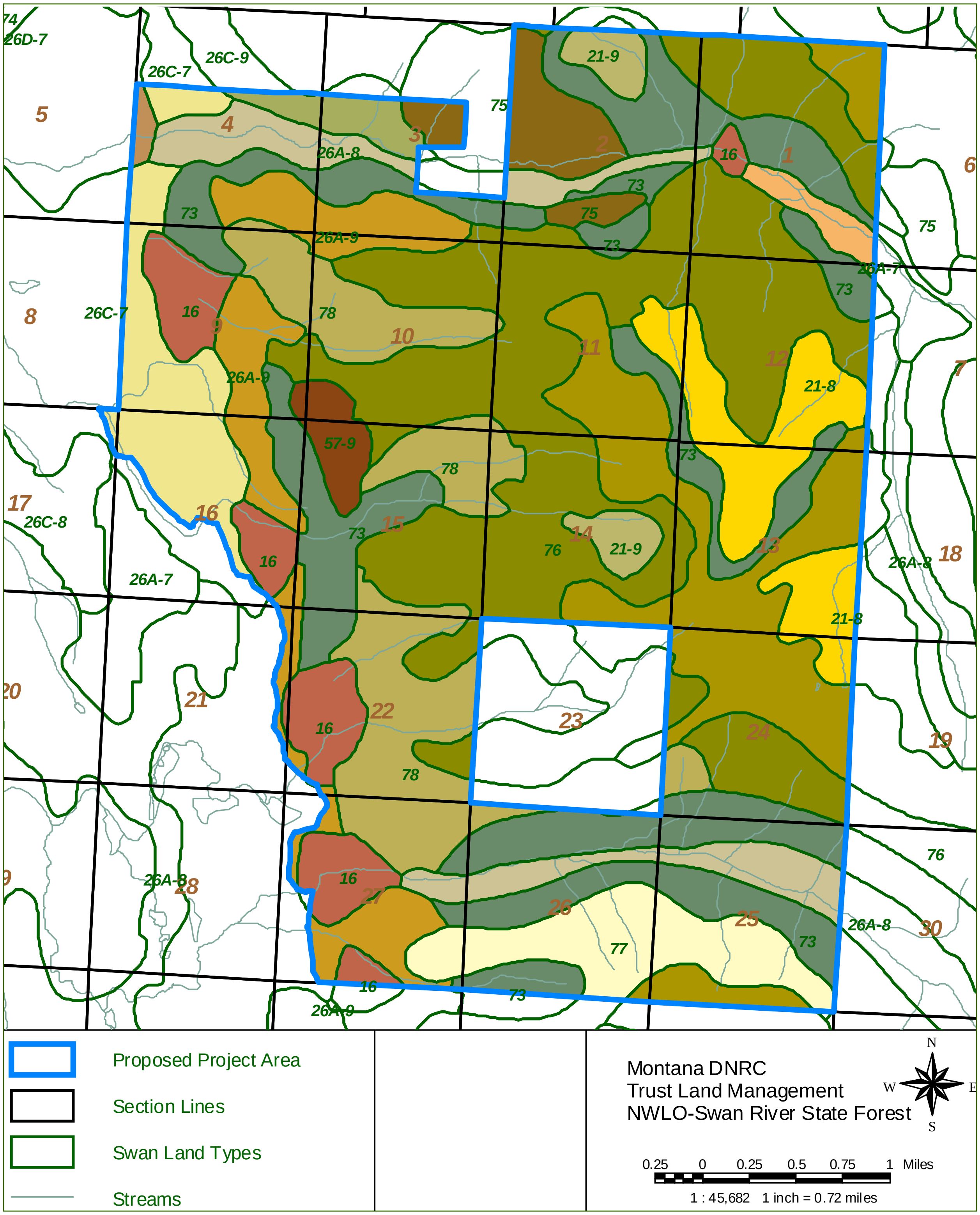
TABLE G-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE THREE CREEKS PROJECT AREA

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLING ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
16	Alluvial fans	Well drained	Low to moderate	Moderate	Fair	Slight	Deep gravel and shallow surface soils. Bear grass competition common. Avoid displacement.
21-8	Cirque basins, 20-40%	Somewhat excessive	Moderate - rock on ridges	Moderate	Fair, droughty	Moderate	Moderate. Deep coarse soils reduce water and nutrients. South slopes droughty. On slopes over 35 percent, lop and scatter, excavator pile, or broadcast burn slash.
21-9	Rock out-crops, shallow glacial till, 40-60%	Moderate to well	Low/moderate	Moderate	Poor	Moderate	Unsurfaced roads are very bumpy due to shallow bedrock.
26A-7	Deep glacial till, 0-20%	Well drained	Low	Moderate (severe if wet)	Good	Low	Deep, productive soil is well suited to tractor operation. Limited dry season of use.
26A-8	Glacial till, 20-40%	Well drained	Moderate	Moderate	Good	Moderate	Deep, productive soil. Fine-textured soil remains moist; check soil moisture. Topsoil depth important.
26A-9	Glacial till, 40-60%	Well drained	Moderate	Moderate	Good	Moderate	Deep, productive soil. Fine-textured soil remains moist, check soil moisture. Topsoil depth important.
26C-7	Glacial moraines, 0-20%	Well drained	Low	Moderate (severe if wet)	Good	Low	Deep, productive soil. Topsoil depth important.
26C-9	Glacial moraines, 40-60%	Well drained	Moderate/high	Moderate/high	Good	Moderate/ high	Deep, productive soil, average season of use. Limit soft-track skidder to slopes less than 45 percent.
26D-7	Glacial moraines, 0-20%	Well drained	Moderate	Moderate	Good	Moderate	Deep, productive soil. Topsoil depth important.
57-9	Residual soils and moderate deep glacial till 20-40%	Well drained	Moderate	Severe displacement	Fair-good; dry on south slopes	Moderate	Steep slopes limit tractor operation. Use cable or helicopter yarding system.
72	Glacial cirque wall, 60-90%	Well drained	Rocky, steep	Low	Very poor	Low	Very shallow soils with excessively steep sideslopes. Cutslopes are difficult to revegetate.

TABLE G-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE THREE CREEKS PROJECT AREA (continued)

73	Glacial trough wall, 60-90%	Well drained	Rocky, steep	Cable - moderate	Fair	High	Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45 percent. Lop and scatter or excavator-pile slash.
75	Rock, residual soils on steep slopes	Somewhat excessive	Rock	Displacement - high	Fair, droughty	Moderate	Shallow and moderately deep, very gravelly/ rocky soils. Cable yarding on slopes over 45 percent, broadcast burn.
76	Geologic breaklands, slopes over 60%	Excessive	Severe; rock outcrops	High displacement	Good	High	Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45 percent. Lop and scatter or excavator-pile slash.
77	Geologic breaklands, slopes over 60%	Excessive	Severe; rock outcrops, steep	High displacement	Poor, subalpine climate	High	Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45 percent. Lop and scatter or excavator-pile slash.
78	Glacial trough wall, 60-90%	Well drained	Rocky, steep	High displacement	Fair, droughty	Moderate	Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45 percent.

FIGURE G-1 - THREEE CREEKS TIMBER SALE PROJECT LANDTYPE MAP



APPENDIX H
ECONOMICS ANALYSIS

INTRODUCTION

This section analyzes the economic impacts associated with each of the alternatives and how they affect revenue to the trust, local employment and income, and other uses of the area. The Three Creeks Timber Sale Project is located in Swan River State Forest in the southeastern corner of Lake County and near the northeastern corner of Missoula County. The sale is in an area of relatively low population density and has produced timber for the area mills since the 1800s. The focus of this section will be on market activities that directly or indirectly benefit the Montana education system, generate revenue for the school trust fund, and provide funding for public buildings.

EXISTING CONDITIONS

The location of Swan River State Forest in relation to the lumber and plywood mills and pulp producers likely to be interested in the timber sale necessitates analyzing economic and demographic data from several counties. Producers from Lake, Missoula, and Flathead counties are all likely to have an interest in this sale. *TABLE H-1 – SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES* contains selected demographic information for each of these counties and the entire State.

TABLE H-1 – SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES

DEMOGRAPHIC	COUNTY			STATE OF MONTANA
	FLATHEAD	LAKE	MISSOULA	
Population 1990	59,218	21,041	78,687	799,065
Population 2000	74,471	26,507	95,802	902,195
Growth rate (%)	2.3	2.3	2.0	1.2
Median age	37.2	38.2	33.2	37.8
School enrollment	13,000	4,560	9,400	157,560

Source: Montana Department of Labor and Commerce and the Office of Public Instruction

Flathead and Lake Counties are widely known for their production of “Flathead cherries” and Christmas tree farms. Flathead County includes the northern portion of Flathead Lake and the west side of Glacier Park. Lake County encompasses a large part of Flathead Lake and includes much of the Flathead Indian Reservation. Missoula County includes the University of Montana as well as several timber-processing facilities. Kindergarten through 12 school enrollment in the 3 counties totals nearly 27,000. Flathead County is the second largest county in terms of population, but boasts the largest school population, 13,000, which is almost half of the total kindergarten through 12 school population for the 3 counties.

The data in *TABLE H-2 – COVERED WAGES AND EMPLOYMENT IN 1999 FOR SELECTED INDUSTRIES IN FLATHEAD, LAKE, AND MISSOULA COUNTIES* shows

TABLE OF CONTENTS

Introduction..................H-1
Existing Conditions...........H-1
Alternative Effects...........H-3
Direct Effects...............H-3
Indirect Effects.............H-7
Cumulative Effects...........H-9

TABLE H-2 – COVERED WAGES AND EMPLOYMENT IN 1999 FOR SELECTED INDUSTRIES IN FLATHEAD, LAKE, AND MISSOULA COUNTIES

INDUSTRY	FLATHEAD COUNTY			LAKE COUNTY			MISSOULA COUNTY		
	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGE (000)	AVERAGE WAGE	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGE (000)	AVERAGE WAGE	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGE (000)	AVERAGE WAGE
Agriculture, forestry, and fishing	382	$14,627	$38,291	84	$1,721	$20,488	408	$13,019	$31,936
Forestry	250	10,045	40,180	38	1,064	28,757	249	8,019	32,164
Construction	3,090	97,117	31,429	444	10,990	24,752	3,064	96,896	31,622
Manufacturing	3,086	119,018	38,056	756	22,750	30,093	2,831	109,047	38,514
Wood products	1,517	64,136	42,278	199	6,690	33,618	923	33,536	36,318
Metals	330	13,241	40,124	NA	NA	NA	58	1,896	32,450
Transportation	684	19,569	28,610	36	646	17,944	1,751	55,322	31,600
Trade	6,401	148,736	23,236	1,248	25,995	20,245	10,026	205,965	20,543
Eating and drinking establishments	1,036	20,269	19,565	685	6,682	9,755	903	16,460	18,220
Financial, insurance, and real estate	2,173	76,451	35,182	304	8,303	27,313	2,353	78,382	33,312
Services	14,390	310,457	21,574	2,428	47,693	19,642	21,992	538,233	24,474
Hotels, etc.	1,235	20,341	16,470	186	1,704	9,161	1,045	13,068	12,506
Amusement and recreation	949	12,769	13,455	72	996	13,833	1,067	12,869	12,066
Government	4,482	149,636	33,386	2,585	76,360	29,540	8,452	306,456	36,260
Total all industries	35,707	$974,651	$27,296	8,283	$209,533	$25,297	42,212	$1,492,033	$28,576

Source: Montana Department of Labor and Industry, Research and Analysis Bureau

employment and income in <u>selected</u> industry categories for each of the 3 counties included in the analysis. Economic activity within these counties varies substantially, although all 3 counties have some timber-related industries.

Flathead County has a larger number of workers employed in timber-related jobs than does Missoula County. Lake County has the smallest labor force and the smallest number of workers employed in timber-related jobs. In all 3 counties, timber-related jobs pay more than the average wage in Missoula County; the average wage in the timber industry is 49 percent higher than the average wage for all industries.

The corresponding wage comparison numbers for Lake and Flathead counties are 50 percent and 39 percent, respectively. Service-industry wages are lower than the average in all 3 counties. The largest difference is in Missoula County, where wages in hotels and the recreation and amusement industries are 60 percent of the countywide average. The service industries provide employment for 2 to 3 times as many workers as the timber industry, but at a substantially lower wage.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

Five options are being analyzed in this EIS. The following estimates are intended for relative comparison of alternatives and are not intended to be absolute estimates of returns, taxes, employment, or wages.

- ***Direct Economic Effects of No-Action Alternative A***

  If No-Action Alternative A were followed, none of the employment, income, or trust fund effects that result from the action alternatives would occur.

- ***Direct Economic Effects of Action Alternatives B, C, D, and E***

  – **Timber Sale Effects**

  The estimated revenue and expenditures associated with the Three Creeks Timber Sale Project are shown in *TABLE H-3 – ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*. Because there are no impacts from timber harvesting associated with No-Action Alternative A, the remaining analysis will focus on the other 4 alternatives. The estimated revenues and expenditures associated with the Three Creeks Timber Sale Project are shown in *TABLE H-3 – ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*. The 4 alternatives analyzed may ultimately be broken into smaller sales, but are treated as a unit for the purpose of this analysis. The volume associated with each of the alternatives is shown in *TABLE H-3 – ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*. The area associated with each alternative is identified in *CHAPTER II - ALTERNATIVES*. Revenue per acre is highest for Action Alternative C, followed in order by Action Alternatives B, D, and E. Revenue estimates for this sale are somewhat lower than would normally be expected; however, each alternative has a significant component of helicopter logging. Helicopter logging is comparatively expensive and bid estimates were reduced to reflect the higher logging costs.

  Stumpage prices, which are currently flat and near the long-term average, are highly dependent on the housing market, which in turn is dependent on, among other things, the interest

TABLE H-3 – ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT

	ACTION ALTERNATIVE			
	B	**C**	**D**	**E**
Harvest volume (tons)	154,557	147,771	167,687	155,838
Stumpage price $/ton	34.41	34.43	32.73	33.26
FI fee (total $)	463,700	443,300	503,100	467,500
Stumpage revenue (total $)	5,318,300	5,087,800	5,488,400	5,183,200
Trust income ($)	3,459,900	3,309,800	3,505,300	3,301,400
State income ($)	5,782,000	5,531,100	5,991,500	5,650,700
Expenditures ($)	2,322,000	2,221,300	2,486,200	2,349,308
Trust income per acre ($)	1,864	1,889	1,806	1,679
Source: DNRC, Trust Land Management Division *Note: Totals may not add due to rounding.*				

rate. The interest rate, in part, determines who can "qualify" to purchase a home. Interest rates are currently at very low levels that have not been seen since the late 1950s and early 1960s. These low interest rates would normally impact the housing market by stimulating new construction to satisfy the demand for housing from individuals who can now "qualify" to purchase a home. The economy is in a period of steady growth. Large federal budget expenditures have had a positive impact on the current U.S. economy. The housing market has generally been very strong and has only recently demonstrated any signs of weakening. As a result, housing starts, while generally increasing, are showing some weakening and have in recent months been lower than last year's level. In addition, mortgage interest rates appear to be increasing, which will offset some of the income gains in the other sectors of the economy.

These factors have resulted in timber prices at or near historical averages. The timber prices used in this analysis attempt to recognize the current market conditions.

TABLE H-4 – NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE shows the differences in revenue to the trusts from the 4 action alternatives.

The school trust income from Action Alternative B is estimated to be $3,459,900, enough to fund the education of 489 students for 1 year based on an average cost of $7,080, as determined from information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 – NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE*. If the sale does not take place, no students are

TABLE H-4 – NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE

	ACTION ALTERNATIVE			
	B	**C**	**D**	**E**
Estimated school revenue	$3,459,900	3,309,800	3,505,300	3,301,400
Students funded	489	467	495	466
Source: Montana DNRC, Trust Land Management Division				

benefited. Thus, one of the "costs" of not harvesting the timber compared to harvesting under Action Alternative B is the loss of financing for 489 kindergarten through grade 12 students for a year. If the trust does not fund these students through the sale of timber, funding must come from other sources, primarily property taxes.

The school trust income from Action Alternative C is estimated to be $3,309,800, enough to fund the education of 467 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 – NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action Alternative C is the loss of financing for 467 kindergarten through grade 12 students for a year. Action Alternative C earns the highest amount of trust income per acre, has the lowest expenditure level of any alternative, and harvests on the fewest number of acres.

The school trust income from Action Alternative D is estimated to be $3,505,300, enough to fund the education of 495 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 – NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action Alternative D is the loss of financing for 495 kindergarten through grade 12 students for a year.

The school trust income from Action Alternative E is estimated to be $3,301,400, enough to fund the education of 466 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 – NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action Alternative E is the loss of financing for 466 kindergarten through grade 12 students for a year.

– **Timber-Related Employment**

Timber harvesting generates employment. *Keegan et al* estimate that, on average, 10.58 jobs are created for every mmbf of timber harvested. Both economic theory and empirical analysis suggest that the marginal effect of an increase in the timber harvested is likely to be different than the average effect because of increasing returns.

The marginal effect may be larger or smaller than the average. Empirical evidence would suggest that in a growing industry, marginal effect on employment is likely to be smaller than the average. In a contracting industry, the marginal effect on employment could be either larger or smaller than the average. In most cases, the marginal effect of increased or decreased timber sales is "lumpy", i.e. two sales of the same size under different conditions might induce a larger

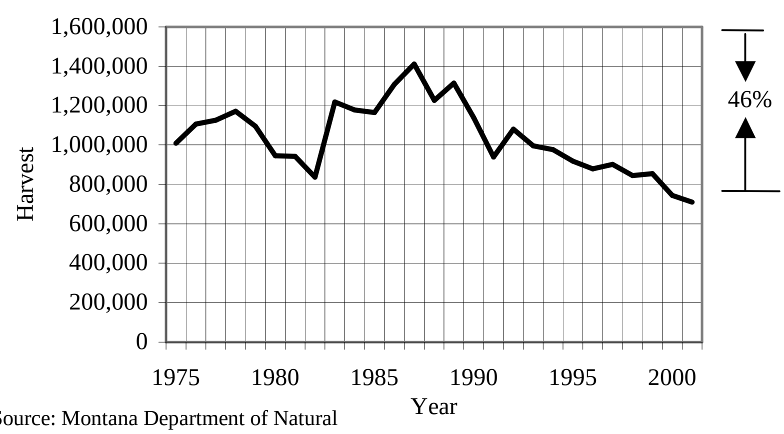
than average employment response in one case and a smaller than average employment response, or nearly negligible, in another.

FIGURE H-1- TOTAL TIMBER HARVEST FROM MONTANA FORESTS (MBF) demonstrates that the amount of timber being harvested in Montana has declined since 1987. The decrease in the harvest since the peak of 1,411 mmbf in 1987 has been nearly 46 percent, to 710 mmbf in 2001. Mills, such as the American Timber Company mill in Olney, have closed, citing a lack of available timber as the cause of their foreclosure (*Missoulian, 1/12/2000*). All of these point to an industry declining in size. Based on the previous discussion, the assumption of the average induced employment of 10.58 jobs per mmbf is reasonable. Because the exact conditions of this sale are unknown, the best estimate of employment, i.e. the average effect on employment, should be used since it is the best estimate available and the marginal effect of the sale is unknown.

A ratio of 10.58 jobs per mmbf of wood harvested implies the direct generation of between 241 and 273 jobs and between $9.3 and $10.6 million in wages, depending on which alternative is chosen. The wages are based on an average wage of $38,874, which was derived from data in *TABLE H-2 – COVERED WAGES AND EMPLOYMENT IN 1999 FOR SELECTED INDUSTRIES IN FLATHEAD, LAKE, AND MISSOULA COUNTIES*. The estimated wages shown in *TABLE H-5 – THREE CREEKS TIMBER SALE PROJECT DIRECT EMPLOYMENT TO INCOME IMPACTS* are the result of employment within the timber industry. Without a timber harvest, income will be lost to the State and communities. Wages in the timber industry are higher than average. This allows individuals working in the industry to obtain higher than average ownership of real personal property. Since much of the revenue for school funding comes from property taxation, higher levels of real property ownership should provide for better school funding.

In addition to these jobs, additional employment is created when the income earned within the timber industry is spent to purchase goods and services elsewhere in the economy. Impacts also occur when logging companies and timber mills purchase goods and services from the local economy. Both of these effects are important since they support other community businesses such as grocery stores, clothing stores, gas stations, etc. The loss of income from this sale would mean not only the loss of

FIGURE H-1 - TOTAL TIMBER HARVEST FROM MONTANA FORESTS (MBF)



Source: Montana Department of Natural Resources, Forest Management Bureau

TABLE H-5 – THREE CREEKS TIMBER SALE PROJECT DIRECT EMPLOYMENT AND INCOME IMPACTS

	ALTERNATIVE			
	B	**C**	**D**	**E**
Direct employment	252	241	273	254
Wages and salaries	$9,779,600	$9,350,200	$10,610,400	9, 860,600

direct income, but the loss of indirect income as well.

The economic impact on schools occurs through ways other than just the direct contribution to the school trust fund from revenue generated through timber sales. Taxes are paid on the facilities the wood industry owns and operates. In the year 2000, the wood industry paid taxes of nearly $1,914,000 to the schools in Flathead, Lake, and Missoula counties. The tax contribution will decline in the future if mill closures, such as American Timber Company in Flathead County, continue. This closure reduced the tax base by an estimated $4.4 million, thereby reducing the taxes received by the school districts by about $28,500. This is a permanent reduction in school funding for over 5 students per year.

INDIRECT EFFECTS

- ***Indirect Economic Effects of No-Action Alternative A***

  None of the indirect effects that would result from the action alternatives would occur.

- ***Indirect Economic Effects of Action Alternatives B, C, D, and E***

  Indirect economic impacts are much broader than those identified under *DIRECT EFFECTS*, above. Some of these impacts are the result of the money from the sales “recycling” through the economy several times. For example, the money spent for groceries by the employee of the timber mill, in part, goes to pay the salary of the grocery store employee, the grocery store employees use that money to purchase groceries for themselves. This, in turn, generates more income for the grocery store employees, etc. Unfortunately, a model of the county that could be used to demonstrate secondary effects is not available. In a broader State-wide context, money paid to wood-industry workers results in increased State income-tax collections, as well as increased purchases in other areas of the State. Income-tax collections from the wages of millworkers alone are estimated to generate between $168,000 and $196,000 in State tax revenue, depending on which alternative is selected. Taxes on indirect wages would add to this tax amount. Since the State revenue is spent on projects State-wide, the entire State shares, in part, in the benefits that result from the timber sale. In particular, Montana schools benefit additionally by being able to use these revenues to fund schools throughout the State.

  – **Nonmarket Issues**

    Quantitative analysis of the economic value of nonmarket benefits and costs will not be part of this analysis because they do not generate income for the trust, although they do affect the well-being of Montana residents. Because of their effects, a short qualitative discussion of nonmarket issues follows: A brief description of the biological impacts is included in order to identify areas where economic values might be affected. A more detailed discussion of the

biological impacts is found in other sections of the report.

- **Environmental Modifications**

  The harvest of timber will modify the undisturbed development of the forest and, as a result, will affect both the short- and long-term habitat and wildlife regimes. How individuals value these modifications is an empirical question and may be viewed either positively or negatively by different individuals. Modifying the undisturbed development of the areas may change the use of the area by some species of wildlife in the short run and may affect the use by other species in the longer term. The estimation of the net social benefit or loss of these impacts is an empirical issue that does not directly affect the school trust fund.

- **Human Use**

  The harvest area has been historically used for recreational purposes such as hiking, hunting, and fishing. While the use of these areas is likely to decline or change during the period of logging, long-term overall use of the area is expected to remain high, and some nonmarket uses are unlikely to change. Fishing, for example, should not be severely affected by the logging since SMZ laws protect streams. The aesthetics will be modified and some individuals will view this as a loss, others may prefer the more-open forest that will result from the harvest. Visual changes are minimized to the extent practicable by limiting the trees harvested in some areas and by “sculpting cuts” to avoid “unnatural” visual lines. Some activities may be enhanced. For instance the logged area may enhance the habitat of some game species, and the increased use of areas by those game species may make the area more attractive to hunters. As in the case of the environmental modifications, the net social benefit or loss is an empirical issue dependent on individual values.

- **Social Impact**

  The area has a substantial presence in the wood-processing industry and, as a result, has institutions established to handle the social requirements associated with this industry. The timber sale is unlikely to add sufficient pressures to these institutions to require their modification. A high rate of employment (low rate of unemployment) is associated with lower rates of crime, domestic violence, alcohol/drug problems, and a healthier, more satisfied community. To the extent that No-Action Alternative A might contribute to unemployment, the harvest might be a short-term negative social impact on the community. Conversely, to the extent that the sale provides employment, the short-term impact will be positive.

- **Roads**

  New roads would be constructed for the sale(s). Existing roads would be improved to handle the logging trucks and provide transport for other equipment used in logging; because of terrain, each alternative has a significant proportion of the sale that will be logged using helicopters. Expenditures for road improvements are identified in each action alternative as part of the sale development cost. Some improvements are also funded through FI fees, as well as other funds set up for this purpose. To the extent that these expenditures are spent locally, local economic conditions would improve. A

portion of the money would leave the area and provide income for other areas of the State and national economies. Culverts, for example, usually come from manufacturers outside of Montana; however, most of the road-improvement expenditures would remain in Montana.

– **Population Impacts**

Logging and milling activities associated with the timber sale are not anticipated to have any long-term impact on the population of the region or the State of Montana.

– **Underlying Assumptions**

Project impact estimation and analysis assumes that most of the economic impact associated with the sales will take place in the 3-county area. The estimates are intended for comparative purposes and do not purport to be the value of the impacts in any absolute sense. Stumpage prices were determined using the current transaction equation modified by professional judgment to reflect current and local market conditions as much as possible.

The FI fee is for a program that provides funding for forest development and improvement and is collected from the logging company as part of their bid. Activities funded under this program include site preparation, tree planting, thinning, roadwork, right-of-way acquisition, etc. The current FI fee for the NWLO area is $19.50 per mbf.

Most of the economic impacts associated with this sale are short term. If no other trees were available for harvest after these sale(s), the tendency would be to return to a lower level of economic activity. A short-term impact that might occur as the local economy contracts is an increase in unemployment as local employers adjust to the lowered production levels.

CUMULATIVE EFFECTS

- ***Cumulative Economic Effects of No-Action Alternative A***

  No cumulative effects would occur.

- ***Cumulative Economic Effects of Action Alternatives B, C, D, and E***

  This sale would be part of the annual harvest of timber from the State of Montana forested trust lands. The net revenue from this sale would add to the trust fund. Annual trust fund contributions have varied widely over the years because the actual contribution to the trust is more a function of harvest than of sales. Harvest levels and prices can vary substantially over time; sales volumes tend to be more consistent. *TABLE H-6 – ANNUAL GROSS REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS* shows the annual gross revenue from harvests for the last 5 years. The net contribution to the trust fund is also affected by the annual costs experienced by DNRC for program management, which varies year to year. DNRC should continue to make net annual contributions to the trust from its forest-management program.

  DNRC has a State-wide sustained-yield annual harvest goal of 53.2 mmbf. If timber from this project is not sold, this volume could come from sales elsewhere; however, the timber may be from other areas and not benefit this region of the State. Long-term deferral of harvesting from this forest would impact harvest patterns, changing both the region where the trees are harvested and the volumes taken. The other areas of the State where harvests would occur if this sale is not sold would be impacted.

TABLE H-6 – ANNUAL GROSS REVENUE FROM TIMBER HARVEST FROM MONTANA FORESTED TRUST LANDS

YEAR	HARVEST REVENUE
2005	$16,596,191
2004	$11,043,525
2003	$8,278,792
2002	$9,686,844
2001	$8,524,150

APPENDIX I
RECREATION ANALYSIS

INTRODUCTION

An issue was raised that forest-management activities may conflict with hunting and general recreational use in the area. The Three Creeks Timber Sale Project area currently experiences moderate recreational use by the general public.

METHODS

The methodologies used to portray the existing condition and determine recreational impacts of the project include determining recreational uses, approximate revenue, and the potential for conflict between project activities and recreational uses.

ANALYSIS AREA

The analysis area includes all legally accessible lands within the Three Creeks Timber Sale Project area (South Lost, Cilly, and Soup Creek watersheds) and the roads that would be used to haul equipment and logs.

EXISTING CONDITION

The Three Creeks Timber Sale Project area receives moderate recreational use throughout the year. The area is primarily used for berry and mushroom picking, snowmobiling, cross-country skiing, horseback riding, bicycling, fishing, hiking, hunting, and camping that includes the use of the Soup Creek Campground. The main roads within the sale area that provide recreational access to the Swan Mountains are South Lost Creek, Cilly Creek, and Soup Creek roads.

TABLE OF CONTENTS

Introduction I-1
Methods I-1
Analysis Area I-1
Existing Condition I-1
Alternative Effects I-2

Currently 3 separate outfitting licenses have been issued for hunting: one each for spring black bear ($700.00 annually), big game ($2,550.00 annually), and mountain lions ($1,850.00 annually). In addition, 6 licenses for fishing outfitters on Swan River are available; 5 are currently in use. The fishing outfitters pay an annual fee of $200.00 each, for a total return of $1,000.00 a year. Finally, a cross-country skiing recreational use license ($200.00 annually) is in effect, and a horseback-riding permit is pending. The total annual return on hunting and fishing outfitting and recreational use permits is $6,300.00, which, spread across 39,833 acres of Swan River State Forest, is approximately $0.158 per acre.

State lands are available for nonmotorized recreational use to anyone purchasing a General Recreational Use License. A recreational fee of $2 for each user is also obtained through the sale of wildlife conservation licenses required for hunting and fishing in Montana. These two types of licenses and fees are not site specific and allow use of all legally accessible State lands. Therefore, determining the amount of recreational use and income resulting from the sale of licenses for a specific area is difficult. In Fiscal Year (FY) 2004, the total gross revenue to the school trust from the General Recreational Use Licenses was approximately $183,660. From March 1 through June 30, 2004, $515,628 in revenue was created under Conservation License sales. As a result, the recreational revenue created totaled $699,288. School trust lands State-wide total 5,160,692 surface acres (*DNRC Annual Report 2004*). Therefore, the average gross revenue is

approximately $0.136/acre ($699,288 divided by 5,160,692 acres) for FY 2004.

Applying the State-wide average revenue per acre to State land within the project area (approximately 10,640 acres), this land produced estimated revenue of $1,447.04 from General Recreational Use and Conservation licenses, assuming the project area receives an average amount of paid recreational use.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Recreation***

  Recreational uses and revenue would not change.

- ***Direct Effects of Action Alternatives B, C, D, and E to Recreation***

  Under any action alternative, harvesting activities may temporarily disturb normal game-movement patterns, which may affect hunter success during project implementation. The activities may also briefly affect cross-country skiing and hiking due to increased noise associated with project activities. The harvesting of Unit 27-19, adjacent to Soup Creek Campground, would be planned for winter (November 16 through March 31); thus, no effect to hunting or recreational campground use is anticipated. Finally, Soup Creek Campground will be closed during the winter for a short period to remove hazard trees during project implementation. The winter closure would not be expected to conflict with periods of high use.

  Short delays due to log hauling, snowplowing, and road construction may inconvenience cross-country skiers, snowmobilers, bicyclists, and other recreationists. However, recreational use and revenue income from outfitting, General Recreational Use Licenses, and wildlife conservation licenses are not expected to change with the implementation of this project.

  The status of open, restricted, and closed roads would not change with the implementation of this project.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Recreation***

  No change is anticipated.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Recreation***

  The amount of recreational use within the project area may change during project implementation. Recreational users may use adjacent areas to avoid harvesting and log-hauling activities. Recreational use and revenue income from Outfitting, General Recreational Use, and Conservation licenses are not expected to change.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Recreation***

  Some recreational users may be reluctant to use roads within the project area if roads continue to deteriorate due to the lack of maintenance associated with the commercial activity. However, recreational use and revenue income from Outfitting and General Recreational Use licenses are not expected to change.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Recreation***

  The harvesting and log-hauling activities within the project area may temporarily displace recreational use to areas adjacent to the project area. All levels of existing recreational use on Swan River State Forest are expected to continue. Therefore, revenue income from Outfitting, General Recreational Use, and Conservation licenses are not expected to change.

APPENDIX J
AIR QUALITY

INTRODUCTION

During scoping, a concern was expressed that timber harvesting and associated activities may negatively affect air quality. Two specific issues were studied in detail:

- Air quality could be affected by smoke from project-related logging slash and prescribed burning.
- Air quality may also be affected by road dust created from harvesting and log-hauling activities.

METHODS

The methodologies used to analyze effects to air quality include estimating the location, amount, and timing of smoke and dust generated by project-related activities.

ANALYSIS AREA

The analysis area for air quality includes all of Lake County, which is part of Montana Airshed 2 as defined by the Montana/Idaho Airshed Group smoke-management program.

EXISTING CONDITION

Currently, the project area contributes very low levels of air pollution into the analysis area or local population centers. Temporary reductions in air quality from the project area exist in the summer and fall due to smoke generated from prescribed burns on the Flathead Indian Reservation or other upwind sources. Locally, dust is produced by vehicles driving on dirt roads. None of the air-quality reductions affect local population centers beyond EPA standards. The project area lies northwest of the Bob Marshall Wilderness Area, which is a Class 1 airshed. All burning activities by major burners comply with emission levels authorized by the Montana/Idaho Airshed Group. The project area is outside of the local high population impact zones, where additional restrictions may be imposed to protect air quality.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Direct Effects Common to Action Alternatives B, C, D, and E to Air Quality***

  Postharvest burning would produce smoke emissions; log hauling and other project-related traffic on dirt roads would increase road dust during dry periods. Members of the smoke-monitoring unit pay according to the amount of particles released to the atmosphere as measured by the tons of fuel that will be burned. Each alternative may be expected to generate similar amounts of fuel to burn. No increase in emissions is expected to exceed standards or impact local population centers or the Class 1 airsheds that exist to the east within the Bob Marshall Wilderness Area, provided that burning is completed within the requirements imposed by the Montana/Idaho Airshed Group and dust abatement is applied to roads during dry periods.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Indirect Effects Common to Action Alternatives B, C, D, and E to Air Quality***

  Since emissions are expected to remain within the air-quality standards, no indirect effects to human health at local population centers are anticipated.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Air Quality***

  Additional smoke produced from prescribed burning on adjacent USFS, private industrial forestlands, and State school trust lands would remain within the standards for air quality. The cumulative effects during peak burning periods could affect individuals with respiratory illnesses at local population centers for short durations. All known major burners operate under the requirements of Montana/Idaho Airshed Group, which regulate the amount of emissions produced cumulatively by major burners.

APPENDIX K
AESTHETICS ANALYSIS

INTRODUCTION

In regard to the Three Creeks Timber Sale Project, the concern was raised that forest-management activities may affect aesthetics. The public generally views the project area while sightseeing or recreating.

ANALYSIS METHODS

The existing conditions and potential impacts to the current views are presented from the perspective of 3 viewing categories. Foreground views include vegetation and topography that are next to roads or trails. Middleground views take in hillsides or drainages from roads and trails. Background views consist of horizons, mountain ranges, or valleys.

The foreground and middleground views are discussed in regard to changes in vegetation, soil, and timber stands along roads. The analysis area for these views is along Soup Creek, Cilly Creek, and South Lost Creek roads, as well as various hiking and cross-country skiing trails.

Background views were analyzed based on the openness of the proposed harvest areas and the patterns of trees that would be left in those areas. The analysis area for this view is the central Swan Range on the east side of Swan River State Forest as viewed from Highway 83.

EXISTING CONDITION

Foreground views along open roads and trails in the project area consist of the immediate landscape up to 200 feet in distance. The foreground views are of open and dense forest stands and openings caused by previous harvesting activities. Firewood gathering and salvage logging have caused some damage to residual live trees; limbs and tops are scattered along skid trails, roads, and ditches.

Middleground views along open roads and trails in the project area are the visible landscape 200 to 1,000 feet in distance, which usually consists of hillsides or drainages. The middleground views are of open and dense multiple-aged forest stands. On State ownership, areas that have been harvested in the past range from 10 to 150 acres and have a dense cover of 6– to 40-foot trees. The old boundaries of harvest units usually follow straight lines and, therefore, appear unnatural.

Background views of the project area are a collection of drainages and ridges that make up a portion of the central Swan Range. The vegetation is a mixture of dense mature forests and past harvest units. Past harvest units range from having few trees to dense retentions of mature trees and abundant tree regeneration. The background landscape of the project area is rarely visible unless viewed from the Soup Creek Road/Highway 83 junction; otherwise, middleground trees obscure visibility for 200 to 1,000 feet.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Aesthetics***

  Due to lack of forest-management activities, shrubs and trees would continue to grow along the roads and limit views.

- ***Direct Effects of Action Alternatives B, C, D, and E to Aesthetics***

  Treatment methods utilized include commercial thinning, seedtree, seedtree with reserves, shelterwood, and sanitation

(within the Soup Creek Campground). As described in *CHAPTER II – ALTERNATIVES,* the acreage proposed for treatment varies by alternative. These treatments would aesthetically affect the harvest area by:

- opening views;
- causing some damage to the residual vegetation;
- creating logging slash;
- disturbing soil along skid trails and landings;
- constructing new roads; and
- creating temporary landing piles along roads within the project area.

Generally, the foreground views would be altered because fewer residual trees would remain. In portions of the project area, the treatments would allow visibility into the middleground, which would appear altered, more open, and have fewer residual trees. The background views, only visible from the Soup Creek Road/Highway 83 junction, would appear altered and show a variety of tree densities remaining on the landscape.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A to Aesthetics***

  Aesthetics would not be indirectly affected by this alternative.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Aesthetics***

  For units that would receive seedtree or seedtree-with-reserves harvest treatments, tree density in the affected area would appear similar to the results of a moderately severe fire. For areas of other treatments, the tree density remaining would appear similar to the results of a low-intensity fire of mixed severity. In both scenarios, the species retained will typically be those of early seral stages that would survive these types of fires.

CUMULATIVE EFFECTS

The following effects of other projects may influence the cumulative effects of aesthetics on the 3 viewing categories:

1) Environmental processes on the landscape, such as wildfires, windstorms, insect infestations, and disease infections, would continue to alter views over time.
2) Salvage harvesting and firewood gathering would alter the foreground by damaging vegetation along roads and leaving some debris on surfaces of roads and skid trails and in ditchlines. Salvage permits administered by DNRC would keep roadside debris to a minimum. Middleground views would appear altered with fewer trees. Background views would remain largely unaltered due to the minimal size of the salvage harvest areas on the landscape.
3) Previous harvest units of the Goat Squeezer timber sales south of the project area, have resulted in altered views with fewer trees along all 3 viewing categories.

- ***Cumulative Effects of No-Action Alternative A to Aesthetics***

  Cumulative effects would be those described above with no additional impacts from project activities.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Aesthetics***

  Any of the action alternatives would result in no additional changes to aesthetics, beyond those expected due to environmental processes and other proposed or ongoing projects. Over time, the altered views may be less visible due to natural processes and forest succession.

APPENDIX L
SCOPING AND MAILING LIST

JANE ADAMS
1401 4TH AVENUE WEST
KALISPELL MT 59901

ALLIANCE FOR THE WILD ROCKIES
PO BOX 8731
MISSOULA MT 59807

ROGER BERGERMEIER
MONTANA TRUST
616 SIMMONS DRIVE
MISSOULA MT 59803

BIGFORK EAGLE
BOX 406
BIGFORK MT 59911

STEVE BRADY
SWAN LAKE RANGER DISTRICT
200 RANGER STATION ROAD
BIGFORK MT 59911

KATHY BRAMER
OFFICE OF PUBLIC INSTRUCTION
PO BOX 202501
HELENA MT 59620-2501

ALLEN BRANINE
FIRE SUPERVISOR
SWAN RIVER STATE FOREST
34925 MT HWY 83
SWAN LAKE, MT 59911

DAN BUSHNELL MT DNRC, ISS
CENTRALIZED SERVICES DIVISION
PO BOX 201601
HELENA MT 59620-1601

TOMMY BUTLER
LEGAL COUNCIL
DNRC
PO BOX 201601
HELENA MT 59620-1601

STEVE CALDBECK
21201 BUFFALO BRIDGE ROAD
BIG ARM MT 59910

KEVIN CHAPPELL
AG & GRAZING MGMT BUREAU
DNRC TRUST LAND MGMT DIVISION
PO BOX 201601
HELENA MT 59620-1601

SOIL SCIENTIST
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804

ANN DAHL
SWAN ECOSYSTEM CENTER
6887 HWY 83
CONDON MT 59826

PAUL ENGELMAN FOREST ECONOMIST
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804

ELLEN ENGSTEDT
MT WOOD PRODUCTS ASSOCIATION
21 NORTH LAST CHANCE GULCH SUITE 207
PO BOX 1149
HELENA MT 59624

WILLIAM ENSIGN
900 RAINBOW DRIVE
BIGFORK MT 59911

BRENNAN FERGUSON
FERGUSON FOREST PATHOLOGY
CONSULTING, INC
P.O. BOX 2127
MISSOULA MT 59806-2127

STEVE FUECHT
PO BOX 1266
CONDON MT 59826

STEVE FUNKE
578 1ST AVE EAST NORTH
KALISPELL MT 59901

DONALD GEE
RT 1 MEADOW CREEK ROAD
BIGFORK MT 59911

RANDY GORDON
SWAN ROUTE
BIGFORK MT 59911

DAVID GROESCHL BUREAU CHIEF
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804

PAT HEFFERNAN
MONTANA LOGGING ASSOCIATION
PO BOX 1716
KALISPELL MT 59901

CESER HERNANDEZ
MONTANA WILDERNESS ASSOCIATION
307 1ST AVE E STE 20
KALISPELL MT 59901-4965

TONY M HULETT LOGGING
PO BOX 5102
SWAN LAKE MT 59911

JOEY JAYNE
STATE REPRESENTATIVE
299 LAMPRY ROAD
ARLEE MT 59821-9747

SARA JOHNSON
15 KOA ROAD
THREE FORKS MT 59752

JEFF JUEL
ECOSYSTEM DEFENSE DIRECTOR
WILD WEST INSTITUTE
PO BOX 7998
MISSOULA MT 59807

STEVE KELLY
BOX 4641
BOZEMAN MT 59772

JIM KRANTZ
PLUM CREEK TIMBER COMPANY
PO BOX 1990
COLUMBIA FALLS MT 59912

FRED LESTIKO
SOUP CREEK RANCH
132 BUFFALO STAGE ROAD
KALISPELL MT 59901

STUART LEWIN
615 3RD AVENUE NORTH
GREAT FALLS MT 59401

TOM LITCHFIELD WILDLIFE BIOLOGIST
DEPARTMENT OF FISH WILDLIFE & PARKS
490 N MERIDIAN ROAD
KALISPELL MT 59901-3854

LUCKOW LOGGING INC
PO BOX 5200
SWAN LAKE MT 59911

BRIAN LONG
INVENTORY SECTION SUPERVISOR
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804

JIM MANN
DAILY INTERLAKE
727 EAST IDAHO
KALISPELL MT 59904

STEPHEN MCDONALD
FORESTRY DEPARTMENT
CONFEDERATED SALISH AND
KOOTENAI TRIBES
104 MAIN STREET SE
RONAN MT 59864

NORM MERZ
WILDLIFE BIOLOGIST
NORTHWESTERN LAND OFFICE
2250 HWY 93 NORTH
KALISPELL MT 59901

NEIL MEYER
SWAN VALLEY AD HOC COMMITTEE
52143 SALMON PRAIRIE ROAD
SWAN LAKE MT 59911

MONTANA ENVIRONMENTAL INFORMATION
CENTER
PO BOX 1184
HELENA MT 59624

MONTANANS FOR MULTIPLE USE
BOX 1557
KALISPELL MT 59903

ARLENE MONTGOMERY
FRIENDS OF THE WILD SWAN
PO BOX 5103
SWAN LAKE MT 59911

DOUG MOOD
PYRAMID MOUNTAIN LUMBER
PO BOX 549
SEELEY LAKE MT 59868

BILL MOORE
PO BOX 977
CONDON MT 59826

BUD MOORE
PO BOX 1070
CONDON MT 59826

TONY NELSON HYDROLOGIST
NORTHWESTERN LAND OFFICE
2250 HWY 93 NORTH
KALISPELL MT 59901

TOM AND MELANIE PARKER
PO BOX 1340
CONDON MT 59826

MARK PHARES
DNRC LEGAL COUNSEL
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804

SARAH PIERCE MEPA SPECIALIST
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804-3199

PLUM CREEK TIMBERLANDS
PO BOX 567
3360 MT HWY 83 N
SEELEY LAKE MT 59868

PATRICK RENNIE
DNRC ARCHEOLOGIST
1625 11TH AVENUE
HELENA MT 59620

STEVE ROLFING
600 BLACKMER LANE
COLUMBIA FALLS MT 59912

SCOTT RUMSEY
FISHERIES BIOLOGIST
DEPARTMENT OF FISH WILDLIFE AND PARKS
490 N MERIDIAN ROAD
KALISPELL MT 59901-3854

GORDON SANDERS
PYRAMID MOUNTAIN LUMBER
PO BOX 549
SEELEY LAKE MT 59868

BOB SANDMAN AREA MANAGER
NORTHWESTERN LAND OFFICE
2250 HWY 93 NORTH
KALISPELL MT 59901

TOM SCHULTZ
TRUST LAND MANAGEMENT
PO BOX 201601
HELENA MT 59620-1601

ROGER SHERMAN
1370 4TH AVENUE WESTNORTH
COLUMBIA FALLS MT 59912

LYNDEE STEVENSON
PO BOX 1061
CONDON MT 59826

RON BUENTEMEIER
FH STOLTZE LAND & LUMBER
PO BOX 1429
COLUMBIA FALLS MT 59912

SWAN VIEW COALITION
3165 FOOTHILL ROAD
KALISPELL MT 59901

PAT TABOR
PO BOX 5081
SWAN LAKE MT 59911

SHAWN THOMAS
MANAGER FORESTRY AND LANDS PROGRAMS
NORTHWESTERN LAND OFFICE
2250 HWY 93 NORTH
KALISPELL MT 59901

STEVE THOMPSON
NATURAL RESOURCE CONSULTANT
BOX 4471
WHITEFISH MT 59937

TRIBAL HISTORIC PRESERVATION OFFICE
CONFEDERATED SALISH AND KOOTENAI TRIBES
PO BOX 278
PABLO MT 59855

DAVE VAN NICE
OFFICE OF STATE AUDITOR
PO BOX 4009
HELENA MT 59604

MIKE VOLESKY POLICY ADVISOR
GOVERNOR’S OFFICE
ROOM 204, STATE CAPITOL
BOX 200801
HELENA MT 59620-0801

TOM WEAVER
DEPT FISH WILDLIFE AND PARKS
490 N MERIDIAN ROAD
KALISPELL MT 59901-3854

CANDACE WEST
DEPARTMENT OF JUSTICE
PO BOX 201401
HELENA MT 59620-1401

ALLEN WOLF
SILVICULTURE SUPERVISOR
NORTHWESTERN LAND OFFICE
2250 HWY 93 NORTH
KALISPELL MT 59901

ROGER ZIESAK
FOREST MANAGEMENT BUREAU
2705 SPURGIN ROAD
MISSOULA MT 59804

GLOSSARY

Acre-foot
A measure of water or sediment volume equal to an amount of material that would cover 1 acre to a depth of 1 foot.

Action alternative
One of several ways of moving toward the project objectives.

Adfluvial
A fish that out migrates to a lake as a juvenile to sexually mature and returns to natal stream to spawn.

Administrative road use
Road use that is restricted to DNRC personnel and contractors for purposes such as monitoring, forest improvement, fire control, hazard reduction, etc.

Airshed
An area defined by a certain set of air conditions; typically a mountain valley where air movement is constrained by natural conditions such as topography.

Ameliorate
To make better; improve.

Background view
Views of distant horizons, mountain ranges, or valleys from roads or trails.

Best Management Practices (BMPs)
Guidelines to direct forest activities, such as logging and road construction, for the protection of soils and water quality.

Biodiversity
The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems where they occur.

Board foot
144 cubic inches of wood that is equivalent to a piece of lumber 1-inch thick by 1 foot wide by 1 foot long.

Canopy
The upper level of a forest consisting of branches and leaves of the taller trees.

Canopy closure
The percentage of a given area covered by the crowns, or canopies, of trees.

Cavity
A hollow excavated in trees by birds or other animals. Cavities are used for roosting and reproduction by many birds and mammals.

Centimeter
A distance equal to .3937 inch.

Commercial-thin harvesting
A harvest that cuts a portion of the merchantable trees within a stand to provide growing space for the trees that are retained. For the Three Creeks Timber Sale Project, thinning would reduce stand densities to approximately 80 to 110 trees per acre.

Compaction
The increase in soil density caused by force exerted at the soil surface, modifying aeration and nutrient availability.

Connectivity
The quality, extent, or state of being joined; unity; the opposite of fragmentation.

Core area
See Security Habitat (grizzly bears).

Cover
See HIDING COVER and/or THERMAL COVER.

Coarse down woody material
Dead trees within a forest stand that have fallen and begun decomposing on the forest floor.

Crown cover or crown closure
The percentage of a given area covered by the crowns of trees.

Cull
A tree of such poor quality that it has no merchantable value in terms of the product being cut and manufactured.

Cumulative effect
The impact on the environment that results from the incremental impact of the action when added to other actions. Cumulative impacts can also result from individually minor actions, but collectively they may compound the effect of the actions.

Desired future conditions
Describes the set of forest conditions determined by DNRC to best meet the SFLMP objectives. The 4 main components useful for describing an appropriate mix of conditions are covertype proportions, age-class distributions, stand-structure characteristics, and the spatial relationships of stands (size, shape, location, etc.); all are assessed across the landscape.

Direct effect
Effects on the environment that occur at the same time and place as the initial cause or action.

Ditch relief
A method of draining water from roads using ditches and a corrugated metal pipe. The pipe is placed just under the road surface.

Dominant tree
Those trees within a forest stand that extend their crowns above surrounding trees and capture sunlight from above and around the crown.

Drain dip
A graded depression built into a road to divert water and prevent soil erosion.

Ecosystem
An interacting system of living organisms and the land and water that make up their environment; the home place of all living things, including humans.

Embeddeness
Embeddedness refers to the degree of armour or the tight consolidation of substrate.

Environmental effects
The impacts or effects of a project on the natural and human environment.

Equivalent clearcut area (ECA)
The total area within a watershed where timber has been harvested, including clearcuts, partial cuts, roads, and burns.

Allowable ECA - The estimated number of acres that can be clearcut before stream-channel stability is affected.

Existing ECA - The number of acres that have been previously harvested taking into account the degree of hydrologic recovery that has occurred due to revegetation.

Remaining ECA - The calculated amount of harvesting that may occur without substantially increasing the risk of causing detrimental effects to stream-channel stability.

Excavator piling
The piling of logging residue (slash) using an excavator.

Fire regimes
Describes the frequency, type, and severity of wildfires. Examples include: frequent, nonlethal underburns; mixed-severity fires; and stand-replacement or lethal burns.

Fluvial
A fish that outmigrates to a river from its natal stream as a juvenile to sexually mature in the river and returns to its natal stream to spawn.

Forage
All browse and nonwoody plants available to wildlife for grazing.

Foreground view
The view immediately adjacent to a road or trail.

Forest improvement (FI)
The establishment and growing of trees after a site has been harvested. Associated activities include:

- site preparation, planting, survival checks, regeneration surveys, and stand thinnings;
- road maintenance;
- resource monitoring;
- noxious weed management; and
- right-of-way acquisition on a State forest.

Fragmentation (forest)
A reduction of connectivity and an increase in sharp stand edges resulting when large contiguous areas of forest with similar age and structural characteristics are interrupted through disturbances, such as stand-replacement fires and timber-stand harvesting.

Frass
Debris or excrement produced by insects.

Geomorphological processes
The observed proportions of habitat types for each reach are within the broad ranges of expected conditions.

Habitat
The place where a plant or animal naturally or normally lives and grows.

Habitat type
Land areas that would produce similar plant communities if left undisturbed for a long period of time.

Harvest units
Areas of timber proposed for harvesting.

Hazard reduction
The abatement of a fire hazard by processing logging residue with methods such as separation, removal, scattering, lopping, crushing, piling and burning, broadcast burning, burying, and chipping.

Hiding cover
Vegetation capable of hiding 90 percent of a standing adult mammal from human view at a distance of 200 feet.

Historical forest condition
The condition of the forest prior to settlement by Europeans.

Indirect effects
Secondary effects that occur in locations other than the initial action or significantly later in time.

Intermediate trees
Characteristics of certain tree species that allow them to survive in relatively low-light conditions, although they may not thrive.

Interdisciplinary team (ID Team)
A team of resource specialists brought together to analyze the effects of a project on the environment.

Landscape
An area of land with interacting ecosystems.

McNeil Coring
McNeil coring is a method used to determine the size range of material in streambed spawning sites.

Meter
A distance equal to 39.37 inches.

Middleground view
The view that is 200 to 1,000 feet from a road or trail, usually consisting of hillsides and drainages.

Millimeter
A distance equal to .03937 inch.

Mitigation measure
An action or policy designed to reduce or prevent detrimental effects.

Multistoried stands
Timber stands with 2 or more distinct stories.

Nest site area (bald eagle)
The area in which human activity or development may stimulate the abandonment of the breeding area, affect successful completion of the nesting cycle, or reduce productivity. It is either mapped for a specific nest, based on field data, or, if that is impossible, is defined as the area within a ¼-mile radius of all nest sites in the breeding area that have been active within the past 5 years.

No-action alternative
The option of maintaining the status quo and continuing present management activities by not implementing the proposed project.

Nonforested area
A naturally occurring area, (such as a bog, natural meadow, avalanche chute, and alpine areas) where trees do not establish over the long term.

Old growth
Working definition - Old growth as defined by *Green et al*.

Conceptual definition - The term old growth is sometimes used to describe the later, or older, stages of natural development of forest stands. Characteristics associated with old-growth generally include relatively large old trees that contain a wide variation in tree sizes, exhibit some degree of a multistoried structure, have signs of decadence, such as rot and spike-topped structure, and contain standing large snags and large down logs.

Overstory
The level of the forest canopy that include the crowns of dominant, codominant, and intermediate trees.

Patch
A discrete (individually distinct) area of forest connected to other discrete forest areas by relatively narrow corridors; an ecosystem element (such as vegetation) that is relatively homogeneous internally, but differs from what surrounds it.

Potential nesting habitat (bald eagle)
Sometimes referred to as 'suitable nesting habitat', areas that have no history of occupancy by breeding bald eagles, but contain potential to do so.

Project file
A public record of the analysis process, including all documents that form the basis for the project analysis. The project file for the Three Creeks Timber Sale Project EIS is located at the Swan River State Forest headquarters office at Goat Creek.

Redds
The spawning ground or nest of various fish species.

Regeneration
The replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods.

Reinitiation
The first phase of the process of stand development.

Resident
Pertaining to fish, resides and reproduces in natal stream.

Residual stand
Trees that remain standing following any cutting operation.

Road-construction activities
In general, “road-construction activities” refers to all activities conducted while building new roads, reconstructing existing roads, and obliterating roads. These activities may include any or all of the following:

– constructing road
– clearing right-of-way
– excavating cut/fill material
– installing road surface and ditch drainage features
– installing culverts at stream crossings
– burning right-of-way slash
– hauling and installing borrow material
– blading and shaping road surfaces

Road improvements
Construction projects on an existing road to improve the ease of travel, safety, drainage, and water quality.

Saplings
Trees 1.0 inches to 4.0 inches dbh.

Sawtimber trees
Trees with a minimum dbh of 9 inches.

Scarification
The mechanized gouging and ripping of surface vegetation and litter to expose mineral soil and enhance the establishment of natural regeneration.

Scoping
The process of determining the extent of the environmental assessment task. Scoping includes public involvement to learn which issues and concerns should be addressed and the depth of the assessment that will be required. It also includes a review of other factors such as laws, policies, actions by other landowners, and jurisdictions of other agencies that may affect the extent of assessment needed.

Security
For wild animals, the freedom from the likelihood of displacement or mortality due to human disturbance or confrontation.

Security habitat (grizzly bears)
An area of a minimum of 2,500 acres that is at least 0.3 miles from trails or roads with motorized travel and high-intensity, nonmotorized use during the nondenning period.

Seedlings
Live trees less than 1.0 inch dbh.

Seedtree harvesting
Removes all trees from a stand except 6 to 10 seed-bearing trees per acre that are retained to provide a seed source for stand regeneration.

Sediment
Solid material, mineral or organic, that is suspended and transported or deposited in bodies of water.

Sediment yield
The amount of sediment that is carried to streams.

Seral
Refers to a biotic community that is in a developmental, transitional stage in ecological succession.

Shade intolerant
Describes tree species that generally can only reproduce and grow in the open or where the overstory is broken and allows sufficient sunlight to penetrate. Often these are seral species that get replaced by more shade-tolerant species during succession. In Swan River State Forest, shade-intolerant species generally include ponderosa pine, western larch, Douglas-fir, western white pine, and lodgepole pine.

Shade tolerant
Describes tree species that can reproduce and grow under the canopy in poor sunlight conditions. These species replace less shade-tolerant species during succession. In Swan River State Forest, shade-tolerant species generally include subalpine fir, grand fir, Douglas-fir, Engelmann spruce, western hemlock, and western red cedar.

Sight distance
The distance at which 90 percent of an animal is hidden from view by vegetation.

Silviculture
The art and science of managing the establishment, composition, and growth of forests to accomplish specific objectives.

Site Preparation
A hand or mechanized manipulation of a harvested site to enhance the success of regeneration. Treatments are intended to modify the soil, litter, and vegetation to create microclimate conditions conducive to the establishment and growth of desired species.

Slash
Branches, tops, and cull trees left on the ground following timber harvesting.

Snag
A standing dead tree or the portion of a broken-off tree. Snags may provide feeding and/or nesting sites for wildlife.

Spur roads
Low-standard roads that are constructed to meet minimum requirements for harvest-related traffic.

Stand
An aggregation of trees that are sufficiently uniform in composition, age, arrangement, and condition and occupy a specific area that is distinguishable from the adjoining forest.

Stand density
Number of trees per acre.

Stocking
The area of a piece of land that is now covered by trees is compared to what could ideally grow on that same area. The comparison is usually expressed as a percent.

Stream gradient
The slope of a stream along its course, usually expressed in percentage, indicating the amount of drop per 100 feet.

Stumpage
The value of standing trees in the forest, sometimes used to mean the commercial value of standing trees.

Substrate scoring
Rating of streambed particle sizes.

Succession
The natural series of replacement of one plant (and animal) community by another over time in the absence of disturbance.

Suppressed
The condition of a tree characterized by a low growth rate and low vigor due to overcrowding competition with overtopping trees.

Texture
A term used in visual assessments indicating distinctive or identifying features of the landscape depending on distance.

Thermal cover
For white-tailed deer, thermal cover has 70 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller. For elk and mule deer, thermal cover has 50 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller.

Timber-harvesting activities
In general, all activities conducted to facilitate timber removal before, during, and after the timber is removed. These activities may include any or all of the following:

- felling standing trees and bucking them into logs
- skidding logs to a landing
- processing, sorting, and loading logs at the landing
- hauling logs to a mill
- slashing and sanitizing residual vegetation damaged during logging
- machine piling logging slash
- burning logging slash
- scarifying, preparing the site as a seedbed
- planting trees

Understory
The trees and other woody species growing under a, more-or-less, continuous cover of branches and foliage formed collectively by the overstory of adjacent trees and other woody growth.

Uneven-aged stand
Various ages and sizes of trees growing together on a uniform site.

Ungulates
Hoofed mammals, such as mule deer, white-tailed deer, elk, and moose, that are mostly herbivorous; many are horned or antlered.

Vigor
The degree of health and growth of a tree or stand.

Visual screening
The vegetation that obscures or reduces the length of view of an animal.

Watershed
The region or area drained by a river or other body of water.

Water yield
The average annual runoff for a particular watershed expressed in acre-feet.

Water-yield increase
An increase in average annual runoff over natural conditions due to the removal of the forest canopy.

APPENDIX N
COMMENTS AND RESPONSES

This section contains comments received from parties interested in the Three Creeks Timber Sale Project DEIS and DNRC’s responses to those comments. A response is not required for those portions of the comments that stated either an opinion or a recommendation. All comments were carefully reviewed. DNRC appreciates both the time and thought that was involved in producing these comments. The decisionmaker will carefully consider each received comment to aid him in deciding on a course of action for this project.

Adams Comments

Jane Adams
Montana Old Growth Project
1401 4th Avenue West
Kalispell, MT 59901

Date Rec'd
10.4.06 w

Karen Jorgenson
Swan River State Forest
34925 Highway 83
Swan Lake, Montana 59911

Dear Karen,

October 2, 2006

Please accept the following comments on the Three Creeks timber sale DEIS. Please keep me informed of all opportunities for public input and participation in this sale. Please plan a field trip in the near future, preferably on a Friday or Saturday.

1. Range of Alternatives All the alternatives are very similar in terms of acres treated, location of units, volume harvested, and do not present an adequate range of alternatives. All the alternatives propose to build many miles of road and harvest in old growth and do not adequately address concerns for wildlife and ecosystem integrity.

2. Sustained yield target driving volume targets One reason given for the high volume is that the sustained yield was increased to 53.2 MMBF. The sustained yield calculation is flawed for a number of reasons and is an unsustainably high volume target (let me know if you would like me to elaborate - I can go on for pages). It is not good forest stewardship to allow a volume target to dictate land management practices.

VEGETATION ANALYSES

3. Current versus historic amounts of Old Growth, and desired future condition It is stated in many places throughout the DEIS that the current age class distribution is not representative of the desired future condition; that older age classes are over-represented and younger age classes are under-represented. For example, the DEIS states (appendix pg C-9) "*Comparison of the current age-class distribution by covertype across the entire SRSF to historical data from Section M333C demonstrates reduced acreage in the seedling-sapling age class and an overabundance in the 150 year old age class.*" Every scientific analysis of historic versus current conditions has concluded otherwise; that there is far less old growth today than historically. DNRC's erroneous conclusion is due to a faulty analysis of historic versus current conditions. This analysis needs a major overhaul.

The DEIS uses different scales to compare historic to current conditions. DNRC is comparing **current** conditions on the **SRSF** to **historic** conditions on the **climatic section**. This is comparing apples to oranges. Instead, the DEIS should compare current conditions on the SRSF to historic conditions on the SRSF, and current conditions on the climatic section to historic conditions on the climatic section. Rather, historic conditions on the SRSF are briefly presented but not carried through the analyses, and current conditions on the larger scale of the climatic section are never presented at all.

DNRC Response

Opening paragraph in letter -

A public field trip regarding the Three Creeks Timber Sale Project EIS was held in June 2005. An additional field trip was planned and cancelled in September 2006 due to lack of public interest and participation. No future public field trips are planned at this time for the Three Creeks Timber Sale Project area.

DNRC will continue to inform all interested parties of opportunities for public input and participation in current and future projects. DNRC also encourages interested parties to view current and future project areas on an individual basis at any time.

1. Please refer to response #41 – Friends of the Wild Swan comment letter.

2. Thank you for your comments.

3. The commenter asserts that there are many references to a desired future condition related to age classes. However, DNRC has not identified a desired future condition for stand age classes. The confusion may result from descriptions presented in the DEIS of average historic conditions for age classes that suggest current conditions may be higher or lower than those expected. However, it should not be construed that DNRC has determined a target or a desired future condition for age classes.

   As to the assertion that other analyses have shown contrary results to those presented in the DEIS, DNRC is unaware of any analysis conducted specifically for Swan River State Forest other than the many specific analyses conducted by DNRC over the years. Every previous MEPA analysis conducted on Swan River State Forest has supported and corroborated the conclusions reached in this DEIS analysis. Because the commenter has not identified any other applicable references, DNRC has no reason to believe the extensive analyses we have conducted and relied on are incorrect.

   The commenter's assertion that DNRC is using different scales to compare historic and current forest conditions may stem from a misconception regarding the meaning of 'historic' conditions. With the SFLMP, subsequent guidance, and *ARM*, the term refers to a condition that promotes long-term landscape-level diversity and does not refer to any one particular historic date or time. DNRC has never intended the term to refer to a single point-in-time snapshot with its correspondingly static view of the environment, believing that such views of the natural landscape seldom represent sustainable or reproducible conditions. If one were to accept the snapshot view of the forested landscape, one could end up clearcutting the entire Swan River State Forest with a single project, or never cutting any of it until it all burned up, while simultaneously claiming those conditions represented historical conditions. Such wild swings in forested conditions are not likely to be sustainable nor particularly desirable to the public. Hence, DNRC takes the position that historic point-in-time snapshots can provide information to help guide management, but they do not provide a cookie cutter with which to stamp out a desired future condition for Swan River State Forest.

   DNRC uses an ecological-based approach to determine average historical conditions that relies on historic age-class distributions by covertype to characterize long-term average conditions by covertype. Then, those characterizations are applied to Swan River State Forest to determine what a long-term average historic condition would look like. The comparison is between similar stands on similar sites with similar growing conditions and does not mix scales. Doing so makes drawing direct comparisons between current conditions and average historic conditions possible.

   The approach also avoids undue reliance on microscale, point-in-time observations that can be wildly skewed in one direction or another because of single disturbance events. The nearby Condon Fire in 2003 provides an example of the problems posed by using small-scale, point-in-time observations to indicate a desired future condition. The fire resulted in an area that is about the size of Swan River State Forest being mostly reduced to a nonstocked condition (i.e., stand replacement fire). Such an event could easily occur on an area as small as

In bold are the values DNRC chooses to compare, and in parenthesis are the values it ignores in the analysis. It is only by this comparison of apples to oranges that DNRC is able to conclude that there is currently more old growth now than historically.

	Historic Old growth	Current Old Growth
Climatic Section	**29%**	(3%)
SRSF	(74%)	**32.4%**

The SRSF had far greater amounts of old growth historically than the climatic section, 74% on the SRSF versus 29% on the climatic section. The DEIS acknowledges this (appendix pg C-9), but dismisses this fact as irrelevant when doing the analysis of historical versus current conditions. There is no justification for ignoring historic conditions on the SRSF and current conditions on the climatic section. They both are integral parts of this analysis and simply mentioning them as sidelines is not enough.

4. The DEIS does not analyze historic verus current within-stand conditions The DEIS states (appendix pg C-3) "The majority of the acres (54 percent) in the project area have never been harvested". This means that 46% have been harvested with some type of treatment. Even salvage harvesting, often considered relatively low-impact, removes habitat components critical for many wildlife species and for the healthy functioning of old growth. The following analyses should all consider past within stand harvesting: Quantity of old growth and old stands, Quantity of old growth attributes (the FOGI analysis); Wildlife species associated with large trees, snags and downed wood; and the vegetation cumulative effects analysis. For example, the DEIS states that the SRSF currently has 12,478 acres of old growth, which is 32.4% of the total acreage. However, there is no assessment of how many of these acres have been subjected to selective and salvage harvesting in the past. This needs to be analyzed and clearly stated.

In addition to analyzing past within-stand harvesting, the DEIS needs to acknowledge that all the action alternatives would move within-stand conditions further from historic in terms of quantities of large trees, and large snags and snag recruits. Table C-10 on page C-42 shows that all action alternatives would increase the acres of stands with a low FOGI classification, and decrease the acres of stands with medium and high levels. This is clearly against the rules and SFLMP.

5. All the action alternatives would move conditions further from historic, which is against the philosophy of the SFLMP and Rules. Acres of old stands, acres of old growth, patch size, within-stand amounts of large trees, snags and snag recruits all would move further from historic conditions. All of these are critical for maintaining ecosystem integrity, forest health and wildlife habitat, and they all have already been seriously impacted by past forest management. The entire management approach in the SFLMP and rules is based on the coarse filter approach. The rules define coarse filter as "*a coarse filter approach assumes that if landscape patterns and processes similar to those species evolved with are maintained, then the full complement of species will persist and biodiversity will be maintained*". The rules also state 36.11.407 Biodiversity- Management on Blocked lands "*Within areas of large blocked ownership, the department shall manage for a desired future condition that can be characterized by the proportion and distribution of forest types and structures historically present on*

Swan River State Forest and yield similar results, i.e., a single uniform age class with no old age or old-growth stands represented.

Finally, every previous professional review of the DNRC analysis procedures, including the Scientific Review Committee for Old Growth, has supported the DNRC process. All of those reviews have clearly stated that determining a desired future condition for an area such as Swan River State Forest should *not* be based on a single point-in-time assessment conducted at the local level. Desired future conditions are meant to be reflective of an average desirable condition, not a static precept taken at a time that may or may not be sustainable or even reproducible. Desired future conditions generally avoid targeting extreme conditions due to the impossibility of exerting such a high level of control over the natural environment, and DNRC recognizes the fallacy of targeting unsustainable conditions.

The commenter's assertion that 74 percent of Swan River State Forest existed as old growth is an incorrect interpretation of the information presented in the 1930s inventory. The 74 percent represents a single point-in-time, coarse estimate of the amount of stands over 160 years that also had a minimum of 4 Mbf per acre. It is not, and cannot be, an estimate of old growth because it relies solely on age and 4 Mbf per acre and ignores all other attributes, including whether or not even one large live tree is present. Additional care must be taken when interpreting the data because the stand ages in the 1930s inventory were based only on ages of trees larger than 14-inches dbh, which greatly over-estimates stand age compared to currently accepted procedures that base age on all trees, or trees over 8-inches dbh. Given the data-collection procedures of the 1930s inventory, it is clear that the 74 percent refers solely to old-age stands having a minimum of 4 Mbf per acre and not to old-growth stands. The 74 percent is not representative of "old growth" stands which require the presence of specified numbers, sizes, and ages of large live trees. Thus, comparing current old-growth levels to the 1930s old-age-stand amounts will always be misleading because only a small subset of old-age stands would meet the criteria for assigning the old-growth label. In other words, estimates for historic amounts of old-age stands will always be higher than the amount of old growth that was present; in some cases, the over-estimation can be very large. For example, even on the highly productive Swan River State Forest, old-age stands equal 63 percent of the area within the project area (*DEIS, Page C-12*), but old growth stands equal only 42 percent of the area (*DEIS, Page C-38*). The commenter is correct in the assertion that DNRC has not stated that the 1930s estimate of old-age stands represents old growth amounts because of the significant differences between old age and old growth. So, while the Department avoids implying that the 1930's data represents old growth, the data is presented in discussions on stand age-class distributions. Notably, the FNF old-growth estimation of 15 percent suggests Swan River State Forest carries far more than historical levels of old growth.

4. The commenter asserts that the analysis should have evaluated differences in historic and current levels of attributes within old-growth stands. Regrettably, no data is available to quantify historic within-stand levels of old-growth attributes, but even if there were the fact that all stands change over time and all old-growth stands eventually begin to fall apart, the utility of such comparisons is marginal at best. The analysis presented in the DEIS does acknowledge that minor salvage harvesting over the years has removed some dead trees, thus affecting snag and subsequent coarse-woody-debris levels. One must also consider the fact that due to various other influences, primarily fire suppression, insect infestations, and introduced diseases, there may be more large live trees, snags, and coarse woody debris present than would have existed historically. Unfortunately, we have no satisfactory method available to divine historic quantities of never-measured attributes, nor does DNRC believe such unwarranted speculation would represent a responsible approach to trust land stewardship.

   DNRC disagrees with the assertion that 'all' action alternatives would move stands further from historic within-stand conditions due, in part, to the many nonquantifiable influences affecting forests and the often-opposing effects of

the landscape". This sale clearly violates the intent of the SFLMP and rules.

6. DEIS needs to justify classification of stands as old growth after heavy harvesting. Stands treated with commercial thin treatments would have approximately 50% of current stocking levels. Shelterwood units would be reduced to approximately 20% percent of current stocking levels. Stands treated with both types treatment would be classified as old growth post-harvest. This is very heavy cutting in old growth. Please provide scientific citations that justify classifying stands as old growth after such heavy cutting.

The scientific experts that DNRC hired in 2000 to evaluate three different approaches to old growth management were clear that heavy harvesting in old growth is not scientifically acceptable. They state "*While cutting is appropriate to reduce density as needed to secure regeneration if fire alone fails to accomplish this, it is not appropriate to reduce large tree numbers down to some minimum threshold*". They also state "*...there is the question of the appropriateness of management manipulation of old-growth stands - both those extant and those in process of development toward old-growth condition. Opinions of well-qualified experts vary in this regard. As long term results from active management lie in the future - likely quite far in the future - considering such manipulation as appropriate and relatively certain to yield anticipated results in an informed guess at best and therefore encompasses some unknown level of risk. In other words, producing "old-growth" habitats through active management is an untested hypothesis*".

7. Fragmentation was analyzed at the incorrect scale. Because fragmentation is a landscape-level issue, the analysis area should be the SRSF. The project area has had relatively little fragmentation to date, whereas the SRSF is highly fragmented as a result of past management activities. The DEIS should disclose that current conditions on the SRSF are highly fragmented, and that the project area is one of the last remaining areas with relatively large patches. In addition, analyses of impacts should clearly disclose that all alternatives will move the forest further away from historic conditions.

8. Old stands and trees are being targeted in this sale. The Insects and Diseases summary, page III-13 states "*Direct effects of the harvest treatments are the removal of trees affected by insects and diseases, those with reduced growth rates due to age, and shade-tolerant trees that do no help meet desired future conditions*". Why should trees be removed simply because they have reduced growth rates due to age? How does that help the insect and disease problem? This comes up again in the fire summary which states, page III-15 "*The majority of timber stands being considered for harvesting are in the mature or older age classes in stands that have not burned since pre-European settlement*". Why are the oldest stands being target for treatment? How does this maintain the full range of forest conditions as directed by the SFLMP?

9. Stand age divisions on the old stand map are incompletely presented. Page III-20 of the summary states that there is a 1930's map that shows historic old stands, and that the age divisions are 0-39, 40-99, 100-150 and 150+. The DEIS fails to mention that the map also shows 200+. The DEIS should include a map showing historic old stands on the SRSF, separating out the 100-150 yr old stands from the 200+ stands. Similarly, the pie charts (figures C-4 to C-6, page C-12 in appendix), and tables (C-5, C-6, and C-7 on pages C-10 and C-11 in appendix) need to separate out the 150+ stands from the 200+ stands. The DEIS states that no information exists for the amount of old growth on the SRSF. It is safe to assume that essentially all of the 200+ stands would meet today's definition for old growth. Although a few stands may not meet the Green et al. definitions for minimum number of large trees,

various influences on attribute amounts. Consider, for example, the contrasting effects of fire suppression and introduced disease on attribute levels. On the one hand, for decades fire suppression has been contributing to the development of higher stand densities and the potential development of more large live trees than would have otherwise occurred if the stands had been exposed to fire. The introduced disease, white pine blister rust, has killed most of the large white pine trees present on the forest, which effectively reduces the number of large live trees, but increases the number of large snags and the amount of coarse woody debris. The complex interactions of these, and other influencing factors, means that simplistic declarations of more or fewer attributes are not demonstrable or supportable for Swan River State Forest.

5. DNRC disagrees with the commenter’s assertions that ‘all’ action alternatives move the forest further from various historic conditions than it is currently. The analysis presented in the DEIS demonstrates that the amount of old growth on Swan River State Forest is moving closer to average historical conditions and snag numbers are likely to exceed average historical conditions by a factor of 2 to 3. DNRC does agree, and presents an analysis in the DEIS, that patch size of stands over 150 years old shows some decreases when compared to a 1930s inventory conducted with very different minimum map-unit sizes and data collection protocols (*DEIS, Pages C-54* through *C-60*). The analysis also states that direct comparisons of the best available information regarding patch sizes is considerably complicated by these protocol differences that, by definition, would suggest approximately an 8-fold decrease in patch size. For example, and as presented in the DEIS analysis, one 14,000-acre ‘patch’ was mapped in the 1930s. DNRC conducted extensive analysis on that patch and discovered that, absent any management effects, the patch would be broken into a great many smaller patches simply because of the mapping differences and that the apparent decrease in stand patch size was not reflective of any actual change to the stands.

6. DNRC went through an inclusive public-involvement effort regarding old-growth definitions and ultimately adopted the *Green, et al (1992)* definition based on numbers, sizes, and ages of large live trees, by old-growth type and site (and *absent* any other criteria). Those definitions were adopted as a direct result of input received from the commenter, Montana Old Growth Project (MOGP), Montana Environmental Information Center (MEIC), and Friends of the Wild Swan (FOWS). Prior to adopting the current definitions, DNRC presented extensive information on the pitfalls of the proposed old-growth definition, such as the concern that recently harvested stands could continue meeting the old-growth definition, a lack of data available to quantify historic old-growth-attribute levels, the inability to distinguish attribute levels, the minimal nature of the definitions, and others. In response to the concerns expressed by the groups mentioned, DNRC adopted the *Green* definitions, despite their inherent shortcomings, and presented them to the Land Board and public in *ARM* as follows:

   ARM – 36.11.403(48): "Old growth" means forest stands that meet or exceed the minimum number, size, and age of those large trees as noted in Old-Growth Forest Types of the Northern Region by P. Green, J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann (1992, USFS Northern Region, internal report).

   It should be noted that no other attributes are required or any other subjective criteria applied when determining if a stand does or does not meet the old-growth definition. Consequently, when a stand meets the old-growth definition from the administrative rules, DNRC labels the stand as old growth – again without applying additional, unspecified criteria that has never been presented to the public or approved as *ARM*.

   Regarding comments made by the Scientific Review Committee for Old Growth, one can extract individual statements to support a number of diverse opinions. For example, the Review Committee noted that DNRC’s *SFLMP* ethoes of maintaining old-growth components in State forests was fundamentally at odds with the trustees’ income-generation obligation, which strongly suggests not retaining any old growth (*Pfister, R.D., W.L. Baker, C.E. Fiedler,* and *J.W. Thomas, 2000*. *Contract Review of Old-Growth Management on School Trust Lands: Supplemental Biodiversity*

most stands would probably far exceed the minimums.

10. Patch sizes of covertypes and old stands are currently far smaller than historic and will be further reduced in size with all action alternatives. Page III-20 has a discussion of historic covertype and old stand patch sizes on the SRSF and states that they were much larger than currently, and the project area had especially large patches. They state "*Overall, current covertype patches on SRSF and the project area are about one-third the size of the historic mean.*" This is stated again on Pg III-21. "*The 150+ year old patches in the project area are larger than the historic mean for SRSF, but are approximately one-third the size of historic patches in the project area.*" The DEIS also states "*Within the project area, the mean old-stand patch size would be reduced to about one-half of current means with all action alternatives*". This is clearly moving away from historic conditions, which is against the SFLMP and rules.

11. The discussion of various estimates of the historic amount of naturally occurring old growth is biased and incomplete (pages C-37 & 38).

A. The DEIS states that DNRC's own analysis suggests that 22% of the SRSF was old growth. Then they say "That analysis used a more restrictive definition for old growth than DNRC currently uses". Please describe the definition previously used to arrive at 22%, and explain exactly how it is more restrictive than the current definition.

B. The DEIS states that the Flathead National Forest estimated an historical range of variability of old growth on all FNF lands of 15-60% (FNF Amendment 21). The DEIS should also include the FNF assessment of current versus historic vegetation , which states (Amendment 21, pg 47) "*The amount of late seral forest has consistently declined across all terrestrial community groups, typically to a level that is below the historic range of variability. This has been accompanied by a dramatic increase in mid-seral forests. In both early and mid-seral forests, large shade intolerant trees are much less abundant than historically, as a result of timber harvest practices that selectively removed the large overstory trees.*"

C. The DEIS mentions Losensky's data for old stands on the climatic section at 29%, but fails to mention his estimate of old stands on the SRSF of 74%.

D. The DEIS summarizes the data on the range of historic old growth on the SRSF at 15-50%. While it includes the low end of the FNF range of 15% , it did not include the high end of 60%. Such biased reporting is not acceptable in a MEPA document.

E. The DEIS should have placed greater emphasis on studies specific to the Swan Valley. For example: (1) Hart's estimate for the Seeley and Swan Valleys that 48% of stands had a significant component of trees over 200 years old. (2) The FNF estimate that 36% of the Swan Valley existed as late seral forest. (3) Lessica's estimate that 52% of the Swan Valley was 180 years old or older. (4) Losenskys estimate of old stands on the SRSF of 74% (which was not even mentioned in this section). This gives a range of 36-74% for historic old growth in studies specific to the Swan Valley.

12. The DEIS states that the SRSF currently has 32.4% of the total acreage of old growth and that this is within the naturally occurring range. However, estimates specific to the Swan Valley indicate that the SRSF is below the historic range.

Guidance 8/02/00. *Helena, MT: Department of Natural Resources and Conservation*).

7. Fragmentation was analyzed at various scales with various methods. The *DEIS* presents fragmentation analysis on *Pages C-21* through *C-23*. Patch size analyses are presented on *Pages C-54 through C-60*. Analyses of fragmentation effects to wildlife are presented on *Pages C-21 through C-23*.

8. The Three Creeks Timber Sale Project DEIS presents extensive information related to insect and disease problems within Swan River State Forest and the project area (*Pages C-23* through *C-32*). Those insect and disease problems result in a diminishing economic value and drove the selection of many older-age stands for treatment. Trees, like any living organism, go through a series of developmental stages from infancy to youth to maturity and on to old age and death. Throughout that progression, the tree generally becomes more and more predisposed to attack by any of a number of insect and disease organisms that can kill the tree. Thus, to strike the appropriate balance between economic and ecologic values, those dying and dead trees are being targeted in this project. Likewise, the stands targeted with this project are those that have elevated or excessive levels of insect and disease problems. The targeted stands are often of an older age than healthy stands because of the causal relationship between insect and disease problems and tree (stand) age, but the stands are not targeted for treatment simply because of their age. However, old-growth and old-age stands, well beyond their prime economic age, can be likely harvest candidates for both economic and legal rationales (*Jackson, 1983. Economic Returns and the Management of Montana's Trust Forest Lands. Helena: Joint Interim Subcommittee No. 2 of the Montana Legislature*).

   The analysis in the DEIS shows that, of the 4,483 acres of old growth within the project area, only about 1,200 acres are being treated, depending on the alternative (*Pages C-37* through *C-53*). During project development, stands with high attribute levels were not preferentially selected for treatment. While stands of low attribute levels are increased in representation, it needs to be remembered that the description is for conditions immediately following treatment. The retention of many large live trees and other old-growth-associated attributes means that these stands will continue to develop additional attributes and soon will no longer be classed as low attribute. Trees and stands grow and, in doing so, levels of various conditions change. In the case of postharvest old-growth stands, their attribute levels will increase over time while still remaining old growth. The maintenance of stands with varying attribute levels, as demonstrated in the DEIS, provides for the maintenance of diversity within Swan River State Forest (see *FIGURES C-13* through *C-18*).

9. The age class analysis completely presents all the relevant information (*DEIS*, *Pages C-9* through *C-19*) without unnecessarily clouding the presentation with partial or incomplete data or the presentation of data that provides no basis for comparison with current information. The 1930s inventory was very coarse, and undue reliance on its spatial accuracy or precision would tend to mislead the reader rather than inform them. While it is tempting to assign greater accuracy and reliability to the 1930's data than is actually warranted, DNRC has carefully attempted to present all of the most salient data into which confidence can be placed. DNRC presents the data with specific caveats intended to prevent confusion over appropriate applications of the data. In addition, no previous analysis has supported the commenter's assertion that all stands of any age class would have met any old-growth definition, and, consequently, DNRC would be remiss in making such an easily refuted assumption.

10. As is presented in the DEIS, patch sizes are believed to have decreased over time (*DEIS*, *Pages C-54* through *C-60*). However, some caveats are also presented that reduce the certainty of the level of decrease (*DNRC*, *Page C-54*). DNRC agrees that patch sizes are reduced from historic conditions, but does not agree that the project runs contrary to the *SFLMP* because of the reduction.

11. A. The more restrictive definition of old growth as described in the *DEIS* included additional attribute amounts that are not included in the current

definition (*Pages C-37* and *C-38*). By default, the addition of more attribute criteria results in a more restrictive old-growth definition.

B. Conclusions reached by USFS for FNF, while interesting, are not applicable to Swan River State Forest, as evidenced by the quote describing conditions that may exist on FNF, but are demonstrated in the DEIS to *not* be the condition existing on Swan River State Forest. DNRC makes no allusions to conditions on landscapes outside of Swan River State Forest that were not analyzed for this project, and, further, makes no commitments to those landscapes.

C. DNRC disagrees with the assertion that Losensky presents data specific to Swan River State Forest. It is conceivable that DNRC is unaware of an existing report, but none of the several reports that DNRC has contracted with Losensky to complete contain the information in question. The 74 percent is from an analysis conducted by DNRC and is not derived from the *Losensky* report referred to by the commenter, nor does the 74 percent refer to old-growth amounts.

D. DNRC was indicating an amount of old growth that may have existed on Swan River State Forest and not on FNF as is represented by the 60 percent. Additionally, as explained in the *DEIS*, differing old-growth definitions will result in differing estimates of historic amounts (*Pages C-37* and *C-38*). However, the DEIS demonstrates that using an old-stand definition rather than an old-growth definition could yield an historic range of old-age stands that exceeds even the 60 percent estimated by FNF, i.e., the 74-percent number discussed earlier. The point of the presentation is that considerable differences exist in estimates of historic old growth, and the definition used can make those estimates diverge even further.

E. DNRC presented the information suggested, but disagrees that the old-stand acres on Swan River State Forest as represented by the 1930s inventory was ever presented by Losensky; DNRC also disagrees that the old-stand acres are equivalent to old-growth acres. The 74 percent referred to represents old age and not old growth. Old age and old growth are not equivalent and, so, DNRC does not presume they are the same.

12. DNRC disagrees that the 32.4-percent old growth on Swan River State Forest is outside the historically occurring range and presents information in the *DEIS* to support that position (*Pages C-37* and *C-38*).

13. The FOGI index uses 4 categories of abundance: none, few, some, many. However, the DEIS does not say what the cutoffs are for these categories. It also does not say how these categories relate to historic abundances. It simply states what they are currently, and how these levels would change with each action alternative. The DEIS needs to provide quantitative definitions in terms of attribute levels for these categories.

The DEIS also needs to compare these current attribute levels with site-specific historic attribute levels. Because many stands in the project area and the SRSF have been entered with previous harvests, they do not have natural, historic amounts of large live trees, snags, and large downed wood. This is not a trivial matter. Landscape level assessments have demonstrated that large trees have been greatly affected by past timber harvest, and are currently under-represented in most forest age classes and forest types (Hann et al. 1997). Further, within-stand reduction in large trees and snags is one of the most profound differences between current and historic forests. This has also occurred on state lands. The SFLMP FEIS states: "*a large proportion of state lands forests have been partially cut on one or more occasions, removing primarily large, high value ponderosa pine and western larch from stands*" (SFLMP FEIS page IV-38). The current radical departure from historic conditions simply cannot be ignored, especially given that this sale proposes to further lower old growth attributes on up to 654 acres.

One way to estimate historic levels of large trees on the SRSF would be to look at old harvest records. Using estimates for total volume harvested, average size (dbh) of trees harvested and volume per tree, and acres harvested, it is possible to estimate the number of large trees harvested per acre. Then add this to existing large tree per acre estimates on previously harvested areas.

14. The analysis for large trees per acre is incomplete. Figure C-15 on page C-45 shows current and post-harvest amount of large trees per acre in old growth stands on the SRSF. This information needs to be in a table form, and more importantly, needs to be broken out for just the project area. By showing the data for the entire SRSF the effects are greatly watered down and harder to visualize. The analysis for coarse woody debris is done at the project area scale, so obviously it is easily done.

15. The analysis for snags is similarly incomplete. Figure C-16 on page C-46 shows current and post-harvest amount of snags per acre in old growth stands on the SRSF. This information needs to be in a table form, and more importantly, needs to be broken out for just the project area. By showing the data for the entire SRSF the effects are greatly watered down and harder to visualize.

16. It appears that the information in figure C-18 on page C-48 and the text description are not congruent. The text states "Approximately 22 percent of old growth contains over 25 mbf per acre". Yet it looks like over 2000 of the 4500 acres of old growth currently have 26+ mbf, which is 44%. This data needs to be in a table form, and needs to be shown for just the project area.

17. Inadequate cumulative effects analysis The DEIS states on page C-49 that the ongoing salvage and sanitation program on the SRSF has resulted in the reduction of some old-growth attributes in many current old growth stands through the effects of timber harvesting. The effects of these previous entries include lower attribute levels in the following categories: fewer acres with high numbers of large trees, lower snag numbers, and less coarse woody debris. Simply stating that there has been past harvesting is not a sufficient cumulative effects analysis! The effects of previous harvests need to be carried through all the appropriate analyses. Since the SFLMP and rules use a coarse filter approach,

DNRC Response

13. The Full Old Growth Index value assignment criteria was inadvertently omitted from the DEIS. It is presented as *ATTACHMENT C-1* following *APPENDIX C - VEGETATION ANALYSIS* in the FEIS.

    DNRC does, however, disagree that the analysis needs to focus on site-specific historic attribute levels, not because they are unimportant, but rather because no data exists with which to make the comparison. As mentioned by the commenter, other researchers in other areas have conducted analyses of some forest components that are also analyzed for this project. In the case of variables mentioned, the conclusions reached by researchers analyzing other landscapes are contradicted by the site-specific analyses completed for this project. In such a situation, DNRC feels it is most informative to focus on the specific project effects on the lands managed by the Department and not on information from other landscapes that may not be applicable to the project-area landscape in question. So, while DNRC does not dispute the results reported by other researchers on the lands they analyzed, it would be a disservice to the beneficiaries and the public to substitute the conclusions reached through analysis of the actual project area with the conclusions reached through analysis of a different landscape. The reference to *SFLMP* comments is out of context in the sense that the comments were general and not specific to Swan River State Forest, nor were they quantified.

14. The analysis presents results for the project area, but *FIGURE C-15* in the *DEIS* is mislabeled to suggest the data is for the entire Swan River State Forest. The correction has been made in this FEIS. The choice was made to present the data in a chart rather than a table because the results were easier to interpret and presentation of both tables; to avoid redundancy, charts were not done.

15. Please refer to response #14 above; the label for *FIGURE C-15* has been corrected in this FEIS.

16. Please refer to response #14 above; the label for *FIGURE C-15* has been corrected in this FEIS. DNRC agrees that the statement referring to amounts of high density old growth is incorrect and has been corrected in the FEIS.

17. *ARM 36.2.522(7)* provides:

    > *"Cumulative impact" means the collective impacts on the human environment of the proposed action when considered in conjunction with other past and present actions related to the proposed action by location or generic type. Related future actions must also be considered when these actions are under concurrent consideration by any state agency through pre-impact studies, separate impact statement evaluation, or permit processing procedures.*

    The cumulative-effects analysis presents information regarding projects that may be ongoing, incomplete, or are being conducted by another organization. In describing changes to the affected environment that have occurred over the years (i.e., the cumulative effects of previous actions), one must necessarily determine an appropriate starting point or baseline. Care must be taken to select a starting point for which data exists. In the case of historical old-growth amounts, attribute levels, or other factors related to old growth, that starting point would be any time after DNRC's initiation of data collection for old-growth description purposes. Because the only harvesting in old-growth stands that has occurred on Swan River State Forest since signing the *SFLMP Record of Decision (ROD)* in 1996 has been minor salvaging, the current condition is the oldest and best data available for describing cumulative effects of previous actions. All effects from previous entries made over the years, and all effects from natural succession, insect and disease attacks, and other factors are represented in the description of the current condition, and no other description of a baseline condition can be made that is based on data. Because no methodology exists for recreating or revisiting the past, DNRC has not included a quantitative analysis of the unknowable conditions existing prior to data collection. The 1930s data does not provide information on specific stands or attribute levels that would enable its use for a cumulative effects analysis. The analysis presented in the DEIS does state qualitatively that it expects that some reductions in some old-growth attributes have occurred over time, but does not present a speculative quantification of the amount. Additionally, because of

and it is assumed that biodiversity will be maintained by maintaining natural historic conditions, it follows that past DNRC actions that have caused substantial change from natural conditions need to be evaluated in the cumulative effects analysis.

18. Regarding both the classification of stands as old growth after commercial thinning and shelterwood harvests, and the FOGI classifications, please keep in mind that the Green et al. large-tree minimums are the **minimum** numbers of large trees necessary to classify a stand as old growth. The Green et al. numbers are the **low end** of the historic range. The average numbers of large trees per acre are considerably higher. Taking everything down to minimum numbers will not maintain the historic range of conditions.

19. The three creeks sale uses the FOGI method to describe stands after harvesting. The scientific review committee that DNRC hired to evaluate three different methods of analyzing old growth had strong reservations about the use of such indices. They state: "*Old growth indexes are not supported by science, especially relative to the weighting of factors. For example, if a high index is mathematically possible with few large trees, then the index would be judged unacceptable based on OG literature to date*".

20. Nowhere in the DEIS could I find an explanation of how old growth was identified or field verified, or how old growth stand exams were conducted. There are various methods available, all with different biases, strengths and weaknesses. Please explain exactly the methods that were used.

WILDLIFE ANALYSES

21. Covertypes and age classes Several statements in this section simply do not make sense given actual on-the-ground conditions. For example, Page F-6 states "*When averaged over all covertypes, stands on Swan River State forest tend to be older than expected*". This statement needs explanation. What is the "expected" condition? Another example is found in the predicted effects to wildlife of the no-action alternative, which states that as stands continue to age "*conditions would lead to an increasing deviation from historic distribution of covertypes and age classes*". Another example is found on page F-6 which states under the direct effects of the action alternatives "*the conversion of older stands to younger stands move the stand proportions toward historic conditions*". Yet another example is found on page F-7, which states under the cumulative effects of all action alternatives (note that your heading here is incorrect) "*These trends generally move toward historic proportions: therefore, native species are generally benefitting from the changes in covertype and age-class distributions*".

These statements are simply not true. The SRSF currently has far less old growth than it had historically, the Swan Valley has less old growth than it had historically, and the larger landscape has only about 10% of the historic amount of old growth. How is it that maintaining or increasing the amount of old growth will move things further from historic? Please look beyond DNRC's analyses to see what the larger scientific community is saying, and keep to real on-the-ground conditions rather than abstract analyses that distort facts.

22. Action alternatives C, D, and E would enter approximately 18 acres of ponderosa pine old stands and reduce the age class to a 100 year old stand. Why was this fact not mentioned in the vegetation analysis? Why was it not disclosed to the general public that ponderosa pine old growth is FAR less abundant than historically?

the interactions of fire suppression, many current old-growth stands likely have elevated levels of some attributes, including large live trees, snags, and coarse woody debris, and other factors; others may have decreased levels of some attributes, such as snags and coarse woody debris, because of the limited salvage harvesting that has occurred.

18. DNRC agrees that efforts to force every stand into identical conditions, regardless of what those may be, does not contribute to maintaining biodiversity; information describing the wide diversity of postharvest conditions is presented throughout the DEIS analysis. This project maintains diversity and limits management treatments to those stands that are rapidly losing economic value and/or sufficient large live trees so that they now, or soon will, no longer qualify as old growth.

19. The Full Old Growth Index is utilized as a communication tool to describe changes to attribute levels in old-growth stands (*DEIS, Pages C-41* through *C-50*). The commenter's conclusions that low index values equate to low attribute levels demonstrates the sole purpose of the index – as a communication tool. The comments presented from the Scientific Review Committee report are taken out of context and do not relate to the current use of the index. Indeed, other organizations are moving toward an index approach for the same reasons DNRC proposed one several years ago – which is, threshold definitions like the ones DNRC currently uses have their own suite of problems. As the commenter has previously mentioned, those problems include posttreatment stands that qualify as old growth; no acknowledgement of stands with high attribute levels that have too few large live trees to qualify as old growth; and no ability to distinguish between stands with minimum attribute levels and stands with very high attribute levels. However, as also mentioned earlier, the commenter and several other groups lobbied extensively for DNRC to adopt the definitions we currently use despite the identified problems with them.

20. Old growth, at the scale of Swan River State Forest, and the timber sale project area are determined using DNRC's SLI *(DEIS, Pages C-38* and *C-42*). The acres of old growth described in the DEIS represent those acres meeting DNRC's old-growth definition based on data that was collected on every sawtimber stand in Swan River State Forest. To further validate the conclusions drawn from the SLI dataset, additional data collection was conducted on some borderline old-growth stands using a fixed-area-plot procedure to provide an independent assessment of whether or not those specific stands within the project area met DNRC's old-growth definitions. Because of widespread insect and disease problems, some previously labeled old-growth stands were sampled to determine whether or not they still met DNRC's old-growth definition. Standard procedures for forest inventory sampling were followed in each instance.

21. DNRC disagrees with the commenter's assertions. The expected condition is that current and historical stands of similar composition growing on similar sites will develop similar age-class distributions. Rationale is presented in the age-class (*Pages C-9* through *C-19*) and old-growth analysis (*Pages C-37* through *C-60*) sections of the *DEIS* and is further explained in responses to questions 3, 4, 5, 6, and others. Also, DNRC has repeatedly and consistently applied its intention from the *SFLMP* and *ARM* that it will not commit to providing additional habitat or stand conditions on DNRC-managed land simply because another landowner has removed that component from their land. Although *ARM* does not rule out extending that concept to the flipside, DNRC also does not currently rely on mitigations provided by the nearly 2 million acres of federally designated wilderness that are in close proximity to the project area to lessen the effects of our activities on the land we manage. The commitment from the *SFLMP* and *ARM* is as follows:

    36.11.407(3): "The department shall design timber harvests to promote long-term, landscape-level diversity through an appropriate representation of forest conditions across the landscape as described in ARM 36.11.404. Where state ownership contains forest conditions made rare on adjacent lands by the management activities of others, the department may not necessarily maintain those conditions in amounts sufficient to compensate

23. Page F-8 states that the estimated range of the historical amount of old growth is 15-32 percent. Please explain exactly where this 15% comes from and how it applies to the SRSF, why higher estimates found for the top end of the range were not included, why Losensky's estimates of historic old growth on SRSF were not included, and old growth estimates specific to the Swan Valley were not included.

24. Page F-8 States "*Past activities that affected old growth were considered in the existing conditions*". Please indicate exactly where this is to be found for the effects of selective harvesting on within-stand conditions. For wildlife, habitat quality is just as important as quantity.

25. Under cumulative effects for coarse woody debris, the DEIS states "*The current levels of coarse woody debris in adjacent stands could mostly offset the changes expected within the harvest units*". Please explain the reasoning behind this statement. Animals have territories, and the size of them is partly determined by habitat quality: As quality goes down (eg. less CWD), territory size often goes up meaning the area supports fewer individuals. Given this, it is not clear how adjacent units will offset the changes in the harvest units. Please also state that downed woody recruits will be less in harvest units, particularly since many decadent trees affected by insects and disease, and likely to die soon, will be harvested.

26. To estimate historic levels of snags, the DEIS snag analysis used mean snag densities reported from uncut stands in Harris (1999). The statistics and assumptions used in Harris (1999) are so flawed as to make the conclusions highly questionable. I have attached an assessment of the statistical validity of this paper that points out some major flaws. In lay-persons terms, the concerns have to do with the assumption that unlogged stands represent the full range of stands within a habitat type. The literature indicates that logging generally took place in low-elevation highly productive sites that tend to produce large trees. Areas that were never logged often were on less productive sites, on steeper slopes, at higher elevations, which generally produce smaller trees and lower quality old growth. Unlogged stands therefore generally had below average old growth attributes and will not provide a complete picture of the range of conditions naturally found in old growth. Of particular concern is the WL/DF type, which has been heavily logged and is quite valuable for wildlife. In Harris (1999), table 1 shows that all the site variables are significantly different between entered and un-entered stands. In particular Harris found that the logged stands were at lower elevations and on less-steep slopes, but strangely the overall regression is not statistically significant. I asked the author about this and he admitted that, but said that the relationships between individual variables were confounded (ie. offset one another) resulting in no net relationship. The statisticians who reviewed Rich's paper further explain why statistical flaws with this analysis, and with Pfister et al. (1977) upon which it is based, produced such questionable results. Given the inherent flaws and unreliability of Harris (1999), it should not be used to make land management decisions, or to conclude that post-harvest snag densities would be "substantially more than expected". The fact is that many snags and snag recruits will be harvested and habitat for snag users will be substantially reduced. Large concentrations of snags provide an abundance of nesting, roosting and feeding opportunities. The select harvesting of large trees that has gone on for years has resulted in far fewer large snags and snag recruits on the landscape than existed historically, and all action alternatives in this sale will push conditions further away from historic.

27. Page F-30 of the DEIS states "*Currently, one trapper has a permit to lawfully set traps for bobcats, consistent with DFWP trapping regulations, on DNRC managed lands in the analysis area. Incidental captures are possible, but not expected. In the event that a lynx is captured, the trapper is*

for their loss when assessed over the broader landscape, except as it coincides with other agency objectives."

22. The treatment of the 18-acre ponderosa pine stand in question is described for each action alternative in the *Effects to Covertype and Age Classes* presented in the *DEIS* on *Pages C-13* through *C-19* in terms of effects to the age of the stand. Additionally, the vegetation analysis specifically presents information on the 18-acre ponderosa pine stand in *TABLES C-7 (Page C-11)* and *C-8 (Page C-18)*.

23. The estimate that 15 percent of the general landscape represents the historic amount of old growth comes from *FNF Amendment 21*. All estimates of historic old stands and old growth available are described in the *DEIS* on *Pages C-37* and *C-38*. There is no estimate of historic amounts of old growth on Swan River State Forest that are presented in the *Losensky* report. DNRC is unaware of any other estimates for old growth applicable to this project, and the commenter has not identified any that are not covered in the analysis.

24. When the existing condition was defined, the current SLI information and field review were used. Both these methods incorporate past activities (*DEIS, Page F-1*). For instance, if past harvesting occurred and the stand has regenerated into a pole stand, the existing conditions recognize that stand as a pole stand, with the understanding that some activity caused this current condition. In the case of old growth, the SLI data and field verification were used to assess the current amount of old growth based on *Green et al. (1992)* (*DEIS, Page C-37*).

25. In treated and adjacent stands, coarse woody debris is relatively high due to insect and disease activities (*DEIS, Page F-15*). The existing condition and No-Action Alternative assessment acknowledges that coarse woody debris has increased, and would continue to increase, over time due to stand age, insects, and diseases (*DEIS, Page F-15*). Following harvests, coarse woody debris loading could increase in the harvest units, with a minimum retention of 15 to 20 tons per acre. Reductions in the size of coarse woody debris is disclosed in the *DEIS* on *Page F-16* along with disclosure of continued recruitment due to retention snags, snag-recruitment trees, and retention trees. Since approximate historical amounts of coarse woody debris and snags would be retained, adequate coarse woody debris is expected to be retained within the harvest units, along with higher amounts in other stands within the analysis area.

26. The *Harris (1999)* publication was used to estimate the historical densities of snags. This publication used *Forest Inventory and Analysis* plots distributed across western Montana, thereby providing the most localized data. DNRC recognizes that these estimates are based on the assumption that "uncut" stands approximate "historic conditions" and that the uncut stands likely have been influenced by human activities and environmental conditions, such as fire suppression, insects and diseases, windthrow, etc. DNRC believes the estimates in this publication provide a reasonable estimate of historical snag densities given the environmental variables and caveats discussed in the publication.

27. Trapping is a legal method to take wildlife species in Montana. As such, DFWP regulates trapping methods and quotas for wildlife species. Since trapping is a legal method of taking wildlife species and a legal recreational activity, trapping is allowed on State trust lands. Because DNRC manages these lands for the trust beneficiaries, a fee is changed for their use. In 2002, the legislature approved an additional $2 fee on each Conservation License to be used for access to State school trust lands for hunting, fishing, and trapping purposes (*§77-1-815*). This fee generates approximately $900,000 annually. Ninety percent of the money raised by this fee is used to compensate the trust for recreational use, while the remaining 10 percent is distributed to DNRC for repair of lease improvements, weed control/management, protection of the resource value, administration/management, and/or maintenance of roads related to public recreational use of State trust land (*§77-1-808, MCA*).

obligated to release the animal without harm". How will DNRC ensure that the animal is released without harm? What type of traps is he/she using? Are they required to report any incidental lynx captures? A recent report from Minnesota of incidental take of lynx shows that of 13 accidental captures, 6 resulted in death. And that is only the reported captures - total fatalities may be much higher. Why is the DNRC even allowing trapping on state lands? Does it generate revenue for the school trust fund? Trapping is an activity that benefits one human, while potentially contributing to population declines that may have high costs for DNRC if the species is listed as endangered. Trapping is no longer an essential economic activity, but a form of "recreation" that causes great suffering to animals trapped as they die an often slow and agonizing death. Please answer the above questions and provide rationale and justification for why MT DNRC is allowing trapping on state lands. And how will this impact lynx populations in relation to this timber sale?

28. Page F-41 of the DEIS states that stands with 40% or greater canopy closure were considered potential fisher habitat. Is this adequate? Will 40% canopy cover provide the dense canopies that can intercept enough snow to provide fisher habitat? Please provide citations that discuss.

29. In the Pileated Woodpecker analysis, why were other ownerships included in the analysis, and the rest of the SRSF left out? It is more appropriate to use the SRSF since DNRC only has control and responsibility over what happens on their land.

30. The DEIS states "*Where regeneration harvests are planned, potential pileated habitat (nesting and foraging) would be removed for 30 to 100 years*". Please explain exactly how they will be able to use a 30 to 100 year old stand. Pileated woodpeckers need large trees with heartrot, which usually are much older than 100 years. There is also no mention of the impacts of roads and firewood cutters taking snags, or that the stands will be more open and snags and trees susceptible to wind-throw.

31. The cumulative effects section for pileated woodpeckers is grossly incomplete in that it does not consider how much pileated woodpecker habitat existed on DNRC lands historically and has been removed by past DNRC timber sales. This would be easy enough to estimate assuming that all or most of the valley bottom Western Larch/Douglas Fir and Ponderosa Pine old growth previously harvested provided high quality pileated woodpecker nesting habitat.

32. The cumulative effects section for pileated woodpecker relies on Harris et al. (1999) for historic snag densities. Please see comment #24 above. Please remove any discussion of Harris (1999) as it is so statistically flawed as to not be reliable enough for land management decisions.

Thank you for considering these comments.

Sincerely,

Jane Adams

Jane Adams
President, Montana Old Growth Project

DNRC Response

28. The SLI data breaks down canopy cover into 4 categories: 0 to 9 percent, 10 to 39 percent, 40 to 69 percent, and 70-plus percent. Fishers tend to use stands with denser canopy closures. *Jones (1991)* found that fishers in Idaho avoided stands with less than 40-percent canopy cover (*DEIS, Page F-44*). In *Region One Fisher Assessment*, USFS used greater than 40-percent canopy cover as a component of their current habitat assessment. Therefore, 40 percent was used as a parameter to describe fisher habitat in the *Three Creeks Timber Sale Project EIS* analysis.

29. The rationale for the analysis area is discussed on *Pages F-1* and *F-47* of the *DEIS*. Generally, the scale of analysis is based on the size of the home range of the species in question. Since the project area occurs near the upper elevation used by pileated woodpeckers and spans 3 major drainages, the subunit scale was deemed appropriate to analyze the effects to pileated woodpeckers. This analysis area incorporates enough area to provide for several home ranges and extends from the valley floor to the upper elevations used by the species (*DEIS, Page F-47*).

30. A. The time estimated for pileated woodpecker use is based on estimates of time needed for canopy closure to increase to 40 percent or more (*DEIS, Page F-47*). Project mitigations retain some large snag and tree structure needed for pileated woodpecker feeding and nesting habitat. However, in harvest units where canopy cover is reduced to less than 40 percent, pileated woodpecker habitat is expected to be removed. Depending on the density and distribution of the leave trees, canopy cover would likely recover to 40 percent or greater over the timeframe stated in the DEIS.

    B. The cumulative effects of public firewood cutting on snag densities are discussed on *Page F-22* and *F-23* of the *DEIS*.

31. The rationale for the analysis area is discussed in the *DEIS* on *Pages F-1* and *F-47*. MEPA requires evaluation of the existing baseline conditions and measures effects of each alternative against that baseline condition. When the existing condition is defined, the current SLI information and field review are used. Both these methods incorporate past activities (*DEIS, Page F-1*). For instance, if past harvesting occurred and the stand has regenerated into a pole stand, the existing conditions recognizes that stand as a pole stand, with the understanding that some activity caused this current condition.

32. The publication *Abundance and Characteristics of Snags in Western Montana Forests (Harris 1999)* was used to estimate the historical densities of snags. This publication used *Forest Inventory and Analysis* plots distributed across western Montana to estimate snag densities, thereby providing the most localized data. DNRC recognizes that these estimates are based on the assumption that “uncut” stands approximate “historic conditions” and that the uncut stands likely have been influenced by human activities and environmental conditions, such as fire suppression, insects and diseases, windthrow, etc. DNRC believes this publication provides a reasonable estimate of historical snag densities given the environmental variables and caveats discussed in the publication.

in the long term, improving the riparian buffer between the road and the South Fork Lost Creek would undoubtedly be better for water temperatures by reducing solar inputs now caused by the proximity of the road. It would be helpful for future EIS fisheries summaries to include information on the distance from the creek to the harvest area (size of buffer zone) as well as the length of harvest units adjacent to each stream.

Thank you for your interest and work toward conserving and improving Montana's aquatic natural resources.

Sincerely,

Leanne H Roulson

Leanne Roulson, President
Montana Chapter of the
American Fisheries Society

American Fisheries Society Comments

AMERICAN FISHERIES SOCIETY
MONTANA CHAPTER

7550 Shedhorn Drive
Bozeman, MT 59718

October 2, 2006

Karen Jorgenson
Project Leader
Swan River State Forest
34925 MT Highway 83
Swan Lake, MT 59911

Dear Mrs. Jorgenson,

The Montana Chapter of the American Fisheries Society (MCAFS) appreciates the opportunity to comment on the Three Creeks Timber Sale Project. The MCAFS is an organization of professional fisheries scientists and students from multiple agencies, universities, and the private sector across Montana. One of our objectives is the conservation, development, and wise utilization of Montana's fisheries. MCAFS has several comments regarding the protection this timber sale will afford fisheries in the Three Creeks area.

Review of the Three Creeks Timber Sale Environmental Impact Statement indicates that all proposed options will have a low probability of impact to fish populations and the associated channel and riparian habitat. The replacement or improvement of the six stream crossings included in all four harvest options probably has the greatest potential to influence the fisheries of the South Fork Lost, Cilly, Soup, and Unnamed creeks. Of greatest concern would be those crossings on the South Fork Lost Creek and Soup Creek, which support native bull trout and westslope cutthroat trout spawning and rearing habitat. Improving stream crossings to more adequately handle flow regimes could result in slight sedimentation downstream initially but seems better for fish habitat in the long term by preventing culvert failures that could result in serious erosion alongside and sedimentation within stream channels. MCAFS encourages stream crossings engineered to accommodate the full natural channel width at bank full flows whenever practicable. These crossings have the added benefit of potentially serving as wildlife corridors, particularly for small mammals and amphibians.

In addition, the relocation of FS road 680 two-hundred feet to the north of South Fork Lost Creek could be another potential source of unnatural sediment inputs initially. However,

DNRC Response

Thank you for submitting comments to the Three Creeks Timber Sale Project DEIS.

Of the 6 road-stream crossings that you refer, 5 would not be “replaced” or “improved”. In fact, the 5 road-stream crossings would be completely removed, which would include rehabilitation of the disturbed area. One new bridge would be installed on a fish-bearing reach of Soup Creek at an existing bridge site, which will greatly reduce the existing potential risks and impacts to fisheries adjacent to the road-stream crossing site. We also feel that these actions would have the potential to greatly and positively influence the fisheries of South Fork Lost and Soup creeks. In the process of removing the 5 road-stream crossing sites and improving the 1 bridge site, there may be minor short-term impacts related to sedimentation. The anticipated short-term and long-term impacts related to these proposed actions are described in the *DEIS, Pages D-9, D-10, E-57, E-60, E-62,* and *E-65*, and this FEIS*, Pages D-9, D-10, E-56, E-59, E-61,* and *E-63*. No culverts will be installed on any fish-bearing streams as part of the proposed actions. A new bridge would be installed on a fish-bearing reach of Soup Creek; this structure would be engineered to accommodate the full natural channel width at bankfull flows. New culverts that would be installed on non-fish-bearing stream reaches in the proposed project area would not necessarily be engineered to accommodate the full natural channel width at bankfull flows, but these culverts will be engineered to accommodate the hydrologic conditions associated with a minimum 50-year flow event. New bridges that would be installed on non-fish-bearing stream reaches in the proposed project area would be engineered to accommodate the full natural channel width at bankfull flows.

The anticipated short-term and long-term impacts related to this proposed action are described in the *DEIS, Pages D-10, E-57, E-60, E-62,* and *E-65*, and this FEIS, *Pages D-10, E-56, E-59, E-61,* and *E-63*. The relocation of USFS Road 680 is expected to have positive long-term impacts to fish habitat in South Fork Lost Creek. Please see pages *E-70, E-74,* and *E-78* of this FEIS. Your comment will be considered for future EIS fisheries summaries. This detailed information can be found throughout the sections *Direct and Indirect Effects of Action Alternatives [B, C, D, and E] on Habitat – Riparian Function* on *Pages E-68* to *E-81* of the *DEIS, APPENDIX E - FISHERIES ANALYSIS* for this project and *Pages E-67* to *E-80* of this FEIS*, APPENDIX E - FISHERIES ANALYSIS* for this project. The anticipated short-term and long-term impacts related to this proposed action are described on *Pages D-10, E-57, E-60, E-62,* and *E-65* in the *DEIS* and on *Pages D-10, E-57, E-60, E-62,* and *E-65* of this FEIS. The relocation of USFS Road 680 is expected to have positive long-term impacts to fish habitat in South Fork Lost Creek. Please see *Pages E-70, E-74,* and *E-78* of this FEIS.]

Your comment will be considered for future EIS fisheries summaries. This detailed information can be found throughout the sections *Direct and Indirect Effects of Action Alternatives [B, C, D, and E] on Habitat – Riparian Function* on *Pages E-68* through *E-81* of the *DEIS APPENDIX E - FISHERIES ANALYSIS* for this project and *Pages E-67* through *E-80* of this FEIS for this project.

Friends of the Wild Swan
P.O. Box 5103
Swan Lake, MT 59911

October 5, 2006

Swan River State Forest
Attn: Karen Jorgenson
34925 Hwy. 83
Swan Lake, MT 59911

Via e-mail to: kjorgenson@mt.gov and fax to: 406-754-2884 - 9pgs

Please accept the following comments on the Three Creeks Timber Sale Project on behalf of Friends of the Wild Swan.

1 Vegetation

• The DEIS claims that there has been logging in the timber sale area since the 1960s and 54% of the area has never been harvested. Does this include salvage logging?

2 • If 54% has not been harvested then 46% has been previously logged. The DEIS claims that the previously logged areas have regenerated. However, when we were on the field trip last year we walked through a 1960s era clearcut that had not regenerated. Also, when DNRC was preparing the South Lost timber sale a few years ago there were high elevation units there that had regenerated but in 30 years the trees were only about 6 feet tall. What is the growth and yield rate of previously logged units in the project area? What treatments were used in the units that are having regeneration problems or slow regeneration? How does this compare to the treatments proposed for this timber sale on similar sites?

The 2004 Sustained Yield Calculation that increased the timber target on state lands and almost doubled the size of this timber sale is predicated on the assumption that: "The yield projections reflect improved growth from stocking control and proper tending of young stands." What will DNRC do differently to improve growth and yield? What personnel are available to tend the new young stands? What additional funds are available to tend the new young stands?

3 • What regeneration surveys have been done in past logging units in the project area? What survival surveys have been done in past logging units in the project area? 61% of the old-growth proposed to be treated is on south to west aspects. What is the survival rate of seedlings from similar treatments on previously logged units with similar aspects?

DNRC Response

1. According to the SLI database, these stands have not been harvested, which includes salvage operations.

2. The harvest referred to and visited during the field tour was harvested in the 1980s and was last planted in 1996. While not fully restocked, the unit contains regeneration and will continue to fill in over time.

   One unit in the project area is regenerating at a slower rate than the others. This unit was clearcut in the 1960s and has ongoing regeneration establishing in the area. The current project does not include any clearcutting and no units are at similar elevations. Units that are on south-to-west-facing slopes will be treated with a shelterwood method, which allows for more shading in the heat of summer, a benefit to seedling survival rates. Refer to the DEIS, *Pages C-5 and C-6,* under *Elevation and Aspects*.

   The 2004 sustained-yield calculation did not directly address volume removals from individual Unit offices, nor did it address the volume target for this project. The annual sustainable yield is calculated on a State-wide basis and is subsequently assigned to individual areas and then unit offices. It is based on current standing volumes and estimated volume growth and incorporates all applicable laws, rules, and regulations, including the philosophy of the *SFLMP* and the direction from *ARM*.

   Statements referring to the improvements in growth expected through silvicultural practices such as precommercial thinning are made in comparison to unmanaged wild stands with no density control. Levels of precommercial thinning derived from the sustained yield model are very close to current levels of accomplishment; thus, it is not expected additional personnel would be necessary to conduct said activities. Funds are made available through Forest Improvement collections, which are expected to exceed $500,000 for this project.

   Recent yield estimates, produced as part of the Department’s sustained-yield calculation, suggest an average State-wide productivity of 123 board feet per acre per year. Productivity varies greatly across the State, with areas like the NWLO demonstrating much higher productivity than areas in eastern Montana. Average productivity for the NWLO is approximately 184.4 board feet per acre per year. Given, Swan River State Forest is comprised of about 38,700 forested acres, a conservative estimate of net growth is about 7.13 MMbf per year. This exceeds the annual volume contribution assigned to Swan River State Forest by about 430 Mbf per year.

   Additionally, for several years, Swan River State Forest did not contribute its calculated share to the annual sustainable yield that DNRC, by law, is required to offer for sale. Given that Swan River State Forest is among the most productive forest lands in the State and has a higher average productivity than the entire NWLO, the growth would be expected to greatly exceed removals even when taking this project into consideration.

3. Following harvesting and planting, previously logged units were checked for regeneration establishment and survival of seedlings. With the exception of the unit identified in #2, all units in the project area have regeneration established. Many of the previously harvested units have been treated with a precommercial thinning operation (dates accomplished include 1985, 1991, 2000, 2004, and 2005).

   Recent survival surveys in planted harvested units are showing approximately an 85-percent survival rate. Treatment methods for this project also take into consideration the aspect of the units and propose shading from the shelterwood treatments to assist survival of the seedlings.

4 • What were the costs of planting, site preparation, slash reduction and precommercial thinning of intermediate silvicultural treatments in past logging units in the project area?

5 • Cedar stands are increasingly rare on the Swan River State Forest due to past logging. The DEIS does not disclose how much cedar will be logged from this proposed project. In a 1978 FEIS for the SRSF Management Plan, the DNRC identified 6,500 acres of western red cedar/queencup beadlily habitat type for the SRSF. With a large percentage of the SRSF being in old growth condition, most of these stands likely contained climax stands of cedar. The 1998 South Lost Creek Timber Sale EIS identified only 874 acres of cedar forest on the SRSF with 462 acres in the South Lost project area. Now, DNRC lumps cedar in with mixed conifer so there is no disclosure of how much cedar will be logged, or the impacts of that logging on forest songbirds or other species. Hutto (1995) identified 11 songbird species in the Northern Rockies that have strong associations with undisturbed cedar-hemlock forest, these include the Brown Creeper, Chestnut-backed Chickadee, Golden-crowned Kinglet, the Nashville Warbler, the Varied Thrush, the Wilsons Warbler and the Winter Wren. How much cedar will be logged from this project in the project area? On the SRSF? How much cedar will be left in the project area? On the forest? What effects does this have on wildlife and songbirds?

6 • Hemlock is a very rare tree species this part of western Montana. The DEIS does not disclose where Hemlock is present in the project area or whether it will be logged.

7 <u>Old-Growth Forest Habitat</u>

• On page C-38 the DEIS states, "Old-growth acreages may change as field surveys are completed and the SLI database is updated." How can you determine effects to old-growth forest habitat if field surveys haven't been done?

8 • Old-growth forest habitat is not connected on the SRSF now. After the proposed logging habitat connections that currently exist will be severed. There is no effort by DNRC to recruit stands as replacement old-growth. There is no identification of which stands would not be entered for a relatively long period of time. This is the place on the SRSF where DNRC can manage for connected old-growth because it is blocked-up ownership, instead this project will further fragment old-growth forest habitat.

9 • This project will manipulate old-growth forest habitat under the assumption that it will still be old-growth after it is logged. The Technical Review Report (Contract Review of Old-Growth Management on School Trust Lands: Supplemental Biodiversity Guidance 8/02/00) commissioned by DNRC in 2000 was very clear:

> "In addition, there is the question of the appropriateness of management manipulation of old-growth stands – both those extant and those in process of development toward old-growth condition. Opinions of well-qualified experts vary in this regard. As long term results from active management lie in the future – likely quite far in the future – **considering such manipulation as appropriate and relatively certain to yield anticipated results is an informed guess at best and, therefore, encompasses some unknown level of risk. In other words,**

DNRC Response

4. Over the course of the last couple of years, the average cost for planting is $44.13 per acre, not including seedling production, seed collection, and administration. The average cost of site preparation and slash reduction has been $123.00 per acre. Due to the type of ground (steepness) and the density of the stand, the average precommercial thinning cost has a range. Recent projects range from $90.00 to $200.00 per acre.

5. Current SLI data shows that there is 10,228 acres of western red cedar/queen cup beadlily habitat type on Swan River State Forest, with 2,704 acres occurring within the Three Creeks Timber Sale Project area. The action alternatives propose harvesting within 4.1 percent (Action Alternative E) to 6.8 percent (Action Alternative C) of this habitat type found on Swan River State Forest. The quantities of cedar to be harvested are not known at this time. Approximate western red cedar volume would be known after a unit has been marked and cruised. Pockets of cedar would likely be retained in these units.

   The species in question, like other native species, are considered in the coarse-filter analysis (*Pages F-6* through *F-8*), since they are not listed as endangered, threatened, or sensitive. All action alternatives would result in a reduction of habitat for species that use mixed-conifer stands within these habitat types, while retaining habitat in other areas on Swan River State Forest.

6. Following field reconnaissance and a search of the SLI database, hemlock is only present in trace amounts within the project area. One stand located in the northwest corner of the forest has a population of western hemlock greater than 10 percent. The limited (trace) amounts of western hemlock are located along South Fork Lost creek. The 2 types of hemlock found in western Montana are western hemlock and mountain hemlock. Western Montana is the extreme eastern edge of the range for both species. Extensive forests of western hemlock occur in southeastern Alaska, coastal British Columbia, and western Washington (*Harlow et al, 1979*). Mountain hemlock has a natural range from southern Alaska south along the coastal ranges of British Columbia, Washington, and Oregon and is known to be present in southeastern British Columbia, northern Idaho and western Montana (*Harlow et al, 1979*). Given the natural range of the species, the trace amounts of hemlock found on Swan River State Forest is to be expected. Hemlock becomes more common as one moves north in the Swan Range toward the Foothills area.

   Minor amounts of western hemlock may be harvested as part of this project.

7. The comment on *Page C-38* refers to future actions wherein additional data collection may result in reclassification of some stands and is not intended to imply field data has not been collected. Data has been collected for all sawtimber stands on Swan River State Forest and was used for all analyses.

8. While connectivity will be reduced, it will be maintained, albeit at a lower level. DNRC has not identified specific stands to manage as replacement old growth given that DNRC has no formal commitment to dedicate or set aside such stands and the controlling language of *77-5-116 MCA* that clearly states set-asides must receive full market value.

9. See response #18 to the Adams' letter. Because DNRC adopted the *Green* definitions, as described above and in *ARM*, it applies the old-growth label to stands that meet the definition. The commenter was among the 3 groups who insisted DNRC adopt the *Green* definitions despite their shortcomings. Comments from the Scientific Review Committee report are taken out of context given they were made in relation to a different process and prior to DNRC adopting its old-growth definitions. Given the clear and objective thresholds provided by DNRC's old-growth definitions, each and every stand can be consistently and accurately assigned to either the old growth class or not. Comprehensive and flexible approaches to defining old growth were rejected by the MOGP, MEIC, and FOWS, and subsequently by DNRC, in order to provide clarity and certainty regarding whether or not a stand would be labeled as old growth due to the presence of large, live trees. The input received from those 3 groups, each of whom has also commented on the Three Creeks Timber Sale

producing "old-growth" habitats through active management is an untested hypothesis." (Page 11 – emphasis added)

The whole old-growth analysis is based on a flawed assumption and untested hypothesis. DNRC may be wishfully thinking that these stands will still be old-growth after logging has occurred in them but you don't know that. What other subtle changes will occur in these stands after they are logged? Will soils be drier? Will mychorrizal fungi be destroyed? How will these changes affect tree and plant growth? That is why the technical review scientists recommended "adherence to the precautionary principle" and "the more common approach of 'reserve strategies' considering the…variables of numbers of old-growth patches, stand size, juxtaposition with other stands, and connectivity." (Page 11)

10 • The Full Old Growth Index (FOGI) weaknesses were also identified by the technical review scientists:

> "The particular OG Index used is not supported by science, especially with the weighting of factors. (A high index with no large trees is possible, but totally unacceptable based on OG literature to date.) Since a large proportion of the acreage would still be open for harvesting, the possibility of removing too many large trees does not provide credibility for the DNRC. Allows "harvesting" in large amounts of OG acreage, when the emphasis should be on the need for "ecological restoration treatments" rather than harvesting. (This is not a play on words! Ecological restoration treatments should be prescriptions with emphasis to enhance old growth development, rather than allowing harvesting down to minimum OG standards.)" (Page 4)
>
> "The main Option 2 weaknesses are lack of scientific support for the proposed index (not available at this time), and public trusts concern about use of the index to allow harvesting of too many large trees." (Page 10)

The concerns expressed by the scientists are precisely what we are seeing with this project. Large amounts of old-growth forests are slated for logging even though the FOGI index still rates them as old-growth, albeit lesser quality old-growth. Again, the old-growth analysis is based on a flawed methodology that is not accepted in the scientific community.

11 <u>Wildlife</u>

• The wildlife analysis cites displacement of wildlife from roads, however, there is no consideration or analysis of illegal motorized use on closed roads or snowmobile use. It also narrows the impacts to the road itself when displacement from motorized use goes far beyond the road. Wildlife, especially grizzly bears and elk, avoid roaded areas. There is no real analysis of the cumulative effects of the existing roads and new roads on wildlife. The DEIS tells us that wildlife are negatively affected but there is no analysis of how that affects breeding, feeding or raising young.

Project, indicated that the presence of specified numbers of large, live trees was the fundamental threshold for labeling a stand as old growth. Again, no other threshold levels for any other attributes are included in DNRC's old-growth definitions.

10. See #19 response to Adams' letter. The Full Old Growth Index (FOGI) is used as a communication tool and apparently serves this purpose well as evidenced by several comments regarding the reduction in FOGI values due to stand treatments. The index is used solely for communication purposes and is not used to justify treatments, or to label or define whether or not a stand is old growth.

11. DNRC plans to manage all roads in accordance with the project design. Monitoring under the *SVGBCA* reveals an 88-percent success rate in restricting roads (*SVGBCA Monitoring Report 2005*). When a breach in a road system is detected, DNRC attempts to repair the closure as soon as possible.

    The disturbance analysis is provided as a relative analysis to produce a hierarchy of disturbance for each alternative (*Page F-2* through *F-4*). This is a coarse-filter analysis that applies differently to each individual species considered and recognizes that the disturbance effects extend beyond the road prism (*Page F-2*). The fine-filter analyses describe the effects of roads on individual species (*Pages F-23, F-31* through *F-39*).

12 • The DEIS also makes broad statements such as "In some harvest units the number of large trees retained could meet the minimum criteria for old-growth; however, these stands may not necessarily meet the needs of old-growth-associated species, especially those species that prefer densely forested climax stands. Where old-growth habitat is altered, old-growth-associated species are expected to lose habitat." And "local reductions in old-growth habitats are expected to reduce habitat availability for species that use these habitats." (page F-8) What species would be affected? How would they be affected? How do these negative impacts affect biological diversity in the project area? On the SRSF?

13 • The lynx analysis does not analyze the effects of compaction from snowmobiles, new roads, increased number of plowed roads, etc. Lynx utilize areas that are unavailable to predators such as mountain lions and coyotes, but when these places are compacted from human use the predators have access to them competing for prey species such as snowshoe hare or preying on lynx.

14 • Some of the assumptions for lynx identified in the DEIS are questionable without proper monitoring; 20-30 year old sapling stands may provide foraging habitat for lynx, provided snowshoe hares are abundant. However, hare response to harvests will be strongly influenced by local conditions and type of disturbance, so one cannot automatically assume that logging will create hare habitat. This will also require that logged stands are not later thinned to promote tree growth, a practice which is rarely identified on public lands managed for timber.

15 • It is our understanding that the main criteria for lynx foraging habitat is the presence of snowshoe hares. Where are the important hare areas in this project area, and what is the estimated population density (low, medium, high)?

• As is noted in the Lynx Conservation Assessment and Strategy, snowshoe hare habitat can occur within old growth forests, depending on the type and local conditions. Have you done any surveys for snowshoe hares in older stands in this area?

16 • The DEIS fails to use accurate information when reporting on open road densities in the South Lost Soup subunit. The DEIS claims that ORD for this subunit are at 31.2%. However, the Swan Valley Conservation Agreement (SVCA) monitoring reports for 2003, 2004 and 2005 disclose that DNRC's open road densities are 35%. That is above the 33% ORD that was to be achieved within 5 years of signing the SVCA. This project will further increase ORD. Under the SVCA the parties were supposed to work towards a long-term goal of 21% ORD in each BMU subunit. DNRC is currently out of compliance with the 33% ORD and is moving in the wrong direction by increasing, not decreasing open road densities.

17 • The Swan Valley Conservation Agreement does not dismiss DNRC from analyzing the cumulative effects of logging, additional road building and disruption of habitat to the grizzly bear. While the DEIS pays lip service to cumulative effects the contents are empty of any analysis. The following concerns need to be addressed:

DNRC Response

12. These statements are made in the *Coarse-Filter Analysis*. This analysis is general by nature; therefore, the species and specific effects are not discussed. However, an overall assessment of the old-growth coarse filter is found under the *Cumulative Effects* heading on *Page F-8*.

13. Although snow compaction might allow travel of coyotes and mountain lions into lynx habitat, spatial separation likely occurs (*Todd et al. 1981, Murray et al. 1994*). Furthermore, *Kolby et al. (in press)* found that coyotes did not show strong affinity for compacted trails and did not prey heavily on snowshoe hares during the winter. Therefore, compacted trails are not expected to affect lynx and were not analyzed in the DEIS.

14. The assumption of sapling stands providing snowshoe hare habitat is appropriate. There is no indication in *APPENDIX C - VEGETATION ANALYSIS* that regeneration would be problematic. Whether regenerating stands undergo precommercial thinning would be determined at a future date. Therefore, the timing and precommercial thinning prescription are beyond the scope of this analysis and would be considered under a separate environmental analysis at the appropriate time.

15/16. DNRC manages habitat and assumes if suitable habitat for a species is present, then the species can use the area in question. DNRC does not manage or monitor hare populations. Additionally, incidental survey information is difficult to interpret without long-term monitoring or research to accompany these data. This is especially true for snowshoe hares populations, which can be cyclic, annually or seasonally. Therefore, a change in survey numbers could be related to habitat, population, or seasonal changes. Without an in-depth study, to determine the cause-effect relationship would be difficult. Therefore, DNRC relies on habitat assessments to measure effects.

17. The commitments made in the *SVGBCA* are based on a subunit basis. Therefore, the Three Creeks Timber Sale Project grizzly bear analysis was based on the subunit scale, not at the ownership within the subunit scale. The percentages reported for the South Fork Lost Soup Grizzly Bear Subunit in *TABLE F*-11 are correct and concur with the figures provided in the *2005 SVGBCA Monitoring Report*. The increase in ORD is due to rerouting the South Fork Lost Road away from the stream to address issues of water quality and sediment delivery. This project fully complies with the road-density standards in the *SVGBCA*.

a) The Biological Opinion (BO) for the SVCA admits that "core areas are limited and restricted to higher elevations; no functional core habitat exists at lower elevations" (BO page 23). Yet the DEIS does not disclose elevationally where the core area is in the subunit, how it is affected, or whether it is adequate.

b) The Fish and Wildlife Service believes that displacement of grizzly bears and under-use of habitat currently occurs, and expects that this would continue" (BO page 23). What is DNRC doing to remedy this?

c) "High road densities in lower elevations may continue to preclude the establishment of home ranges by (successful reproducing) adult females" (BO page 24). What is DNRC doing to remedy this?

d) "Blocks of core habitat of sufficient size to be functional are absent at lower elevations . . . and would remain absent under the terms of the agreement." (BO page 25) What is DNRC doing to remedy this?

18 • The DEIS fails to analyze the effects on fisher of decreasing habitat quality and quantity. Merely stating that habitat will decline is not adequate. Where will fisher live, breed and shelter for the next 20 years while they are waiting for habitat to improve? DNRC cannot rely on other ownerships as a surrogate for eliminating habitat on state lands. How will managing for low habitat values impact fisher in the near and long-term?

19 • Why have fisher corridors widths been decreased from those delineated on other projects in the SRSF in the past few years? What is the scientific basis for this change?

20 • The DEIS fails to analyze the effects on pileated woodpecker. The DEIS discloses that habitat will decline but how does that affect the woodpeckers living there now? How many are using the area now? What surveys have been done? Where will woodpeckers be displaced to? Is that habitat adequate? Instead of truly analyzing the impacts the DEIS makes vague statements that habitat may improve in 80 to 100 years. And that is, of course, if no more logging takes place in the interim.

21 • The DEIS fails to analyze the cumulative effects on elk and mule deer. Winter range thermal cover was reduced to below scientifically recommended levels in the Goat Squeezer timber sale project. Did that reduction in thermal cover squeeze more big game into this project area? What are the effects of this project on calving grounds? On spring range?

22 • How much of the project area, on SRSF lands, was historically big game winter range? Please be more specific regarding the expected population impacts on big game from your proposed reductions in big game winter range, instead of just saying a reduction in carrying capacity may occur. How much are populations expected to decline by?

23 • Why were the specific alternatives selected in regard to removal of big game winter range? For example, why weren't much lower levels considered? Also, why were particular winter range stands selected for removal, and not others?

DNRC Response

18. *TABLE F-13* displays the reductions in security core. A map was added to the *FEIS* to show the current location of potential security core areas (*FIGURE F-8*). The USFWS determined the adequacy of the long-term security core areas and issued an incidental-take statement.

    Some incidental take was anticipated and was authorized by the USFWS as terms of the *SVGBCA* when it was established. DNRC is conducting management activities in compliance with the stipulations in the *SVGBCA*, thereby minimizing impacts of forest management to grizzly bears.

19. *Page F-45* gives rationale for the statement that "the risk of these alternatives reducing the quantity or quality of fisher habitat to the point where fishers can no longer use the analysis area is low."

20. The width of fisher corridors from the *SFLMP* guidance to the *ARMs* decreased from 165 feet to 100 feet on class 1 (perennial) and 83 feet to 50 feet on class 2 (intermittent) streams. This change was due to an administrative decision made to meet State trust obligations while accommodating wildlife habitat considerations. Initially, riparian corridor widths were determined by considering riparian widths that incorporated 75 percent of radio relocations of fishers studied in Idaho. During the rule-making process, the width was narrowed to widths that incorporated 0 percent of radio relocations reported in this same study (*Jones 1991*).

21. DNRC's wildlife analysis is based on habitat parameters and the changes to those parameters. Surveys or population estimates for pileated woodpeckers in the analysis area were not conducted. In western Montana, pileated woodpeckers appear relatively common, are not listed as a species of concern (outside DNRC), and show increasing distribution (*Skaar 2003*). Based on changes to the habitat, the DEIS states that the alternatives "could result in a moderate risk of reducing use and reproduction of pileated woodpeckers in the analysis area in the short-term" (*Page F-50*). Long-term future harvests are beyond the scope of this analysis and would be considered when a specific project is proposed.

22. The Goat Squeezer winter range and subsequent effects to big game primarily affect white-tailed deer. Conversely, the Three Creeks Timber Sale Project area does not provide winter range for white-tailed deer, and white-tailed deer show high fidelity to winter ranges; therefore, white-tailed deer use of the elk/mule deer winter range in the Three Creeks Timber Sale Project area is not expected. The effects of calving grounds and spring range were not raised as issues in this area. No calving grounds have been designated in the analysis area. Furthermore, if isolated calving areas occur in the project area, timing and cover stipulations under the *SVGBCA* would retain hiding cover and reduce disturbance for calving elk. On spring ranges, removal of canopy cover would allow for increased forage and earlier green-up resulting in a benefit to big game species.

23. Winter ranges are generally defined due to their location within the landscape. Winter ranges tend to have lower snow accumulations than surrounding areas due to the influence of elevation, aspect, and climatic variables. The historical amount of potential big game winter range is likely unchanged from the present amount; however, patches of dense forest cover associated with winter ranges likely retreated, advanced, and shifted over time due to the occurrence of natural disturbances such as wildfire. Today, logging can also affect the quality and carrying capacity of these winter ranges. However, the analysis concludes that the effects of all action alternatives would result in a low risk of decreasing carrying capacity on this portion of the elk/mule deer winter range because of a variety of factors (*Pages F-53 to F-54*). Therefore, no detectable population changes are expected.

24 • Has DNRC defined how much winter range needs to be maintained over time on this landscape to maintain stable big game populations? What are your management goals for big game winter range and associated populations on SRSF lands? Do you have any limitations on the amount of big game winter range that you can remove over a given period of time?

25 • Why were the specific alternatives selected in regard to removal of habitat for the other species analyzed? Why were particular nesting or denning stands selected for removal, and not others? Do you have any limitations on the amount of sensitive, threatened or endangered species habitat that you can remove over a given period of time?

26 • For all wildlife DNRC needs to quantify what does current habitat availability, local population monitoring, and current status of the species indicate about current population health in this landscape, or in other words, <u>is the current habitat enough?</u> If it is, how much more can you take and still not trigger significant population impacts? If there currently isn't enough habitat, how can you justify taking more?

27 • What conservation strategies does DNRC have to ensure that biological diversity is maintained on the SRSF? The SFLMP rules do not constitute an overall conservation strategy, they are broad guidance. We realize that conservation strategies are being developed with the Habitat Conservation Plan for lynx, grizzly bear and bull trout, but what conservation strategies does DNRC have for sensitive species, wolves, and bald eagles?

28 • There is a disconnect in the analysis, all the wildlife species analyzed in the DEIS require corridors to move for foraging, denning, nesting and seasonal habitats. But we don't know: Where are these corridors? What is the habitat quality in them? What size are they? Are they wide enough to protect from edge effects and provide security? Are they fragmented by roads or past logging units? How much canopy cover, thermal cover or hiding cover is in them? How much down woody debris is in them? What type of habitat is considered suitable?

Corridors of interior forest habitat between old growth habitat have been recommended by the old growth Technical Review Team, and they recommend a minimum width of >100 meters. Do you have any actual width criteria you are using at present to define corridors in the project area? DNRC needs to map all corridor habitat in the project area, and define both current and long term objectives for maintaining these corridors over time.

29 • DNRC must disclose any sightings, nests and/or dens of sensitive, threatened and endangered species in the project area and what is being done to protect them.

30 <u>Fisheries/Hydrology</u>
• The DEIS contains a summary of anticipated project-level monitoring but does not disclose how long the monitoring will be done. How often it will be done. Whether there is funding available for the monitoring. Also, the monitoring does not contain the

DNRC Response

24. The harvest unit selection addressed the project objectives (*Page I-2*) and was modified to mitigate other resource issues. Big game thermal cover was not an issue that modified the objective-based proposal.

    However, one of the project objectives (*DEIS, Page I-2; FEIS, Page I-2*) directed the ID Team to consider harvesting in areas where winter-harvesting operations are limited. This objective is aimed at retaining winter-harvesting opportunities lower in the South Fork Lost Soup Grizzly Bear Subunit that could be used to reduce the amount of volume (thermal cover) needed from the Goat Squeezer Grizzly Bear Subunit during the 2012 through 2014 active period. In combination with that objective was the objective of addressing insect and disease activities, and many of those units are in the mid-elevation zones for this particular area.

25. *ARM 36.11.443* outlines DNRC management for big game winter range.

26. The harvest units and treatments were selected to meet the stated project objectives (*Page I-2*) and were modified to mitigate other resource issues. DNRC applies a coarse-filter management philosophy that attempts to emulate the historic conditions found prior to European settlement (*DNRC 1996*). The amount of habitat allowed to be removed over time is managed on a project-by-project level under each environmental analysis. Under each environmental assessment, the decisionmaker must weigh the effects to wildlife and their habitat, considering amounts that would be affected and the impacts to the species of concern.

27. Please refer *COARSE FILTER ANALYSIS, Introduction* (*Page F-2*).

28. *ARMs* provide the direction that explains how DNRC manages habitat for bald eagles, gray wolves, and sensitive species. Specific measures are contained in *ARMs* for threatened, endangered, and sensitive species that are most likely to be influenced by forest-management activities.

29. This information is provided under the *Forest Connectivity Analysis* on *Pages F-8* through *F-13* and in *FIGURES F-1* through *F-5*.

30. Species use of the area is based on available habitat and is supported by observations. The criteria for habitat assessment along with any documentation of use are discussed in the *DEIS* under the species in question. DNRC reports sightings from field staff of threatened and endangered and sensitive species to the Montana Natural Heritage Program, and observations are reported in the DNRC *5-YEAR SFLMP Monitoring Report*.

Bull Trout Restoration Team's recommended criteria in *The Relationship Between Land Management Activities and Habitat for Bull Trout* (hereafter Land Management Report). The Three Creeks Timber Sale does not contain the monitoring components contained in Table 3 of the Land Management Plan (other than fine sediment and redd counts which is routinely done by Fish, Wildlife and Parks).

The Land Management Plan strategy was adopted so as not to impose "one size fits all" standards but rather to apply an adaptive management approach which would include monitoring habitat components, criteria based standards and delineation of caution zones. Activities that occur within the "caution zone" (i.e., 100 year floodplain plus 150 feet on either side and/or the hydrologic boundary of the watershed) may inherently pose some risk and should not occur unless sufficient information is available to reliably demonstrate that the activity will not adversely affect habitat characteristics necessary to support bull trout. Why isn't there a "caution zone" delineated for this project? Why is DNRC using bankful width instead of the 100 year floodplain to delineate a buffer zone? What data from past projects on the SRSF exists to reliably demonstrate that logging within a "caution zone" will not adversely affect habitat characteristics necessary to support bull trout?

31 • The DEIS delineates a mere 25 foot no harvest buffer on key bull trout spawning streams without providing any science to support it. This buffer is weaker than the best scientific research suggests for aquatic species. As stated above, the Montana Bull Trout Restoration Team's Science Group suggested a caution zone that ranged from the 100 year floodplain plus 150 feet to the whole watershed. The Forest Service's Inland Native Fish Strategy requires 300 foot buffers on each side of the stream. The USFWS Interim Conservation Guidance states:

> **The Service believes activities that occur within the caution zone may inherently pose some risk, and should not occur unless sufficient information is available to reliably demonstrate that the activity will not adversely affect habitat characteristics necessary to support bull trout.** (emphasis added) USFWS Bull Trout Interim Conservation Guidance, 12/9/98 citing Montana Bull Trout Scientific Group's 1998 report "The Relationship between Land Management Activities and Habitat Requirements of Bull Trout."

The caution zone they refer to is the 100 year flooplain + 150 feet for both bull trout core and nodal areas. DNRC is clearly out of step with other agencies and scientists.

32 • The Fisheries analysis relies on the hydrology analysis that only looks at the long-term decrease in sediment from removing old bridges, up-grading roads, relocating the South Lost road from the streamside, etc. However, all of these actions will increase sediment in the short-term yet this is not mentioned or analyzed in the DEIS. The DEIS does not disclose how many culverts will be replaced in the road reconstruction, how many new culverts will be installed, where they are located and what the timing of all this road work is. In other words, will all these activities be taking place at the same time? We must assume that they will because there is only a three year window to complete this work. So, there will be impacts to fish habitat and these are not analyzed or disclosed in the DEIS. Nor is the DEIS clear as to whether the temporary roads will be fully reclaimed.

DNRC Response

31. Postharvest redd count, McNeil core, and substrate monitoring is expected to occur during at least 5 consecutive years in South Fork Lost and Soup creeks if one of the action alternatives is selected. Postharvest fish habitat, riparian stand, shade, and large-woody-debris monitoring is expected to occur during at least 1 year in South Fork Lost and Soup creeks if one of the action alternatives is selected. Postharvest stream temperature monitoring is expected to occur during at least 3 consecutive years in South Lost, Cilly, and Soup creeks if one of the action alternatives is selected. Postharvest redd count, *McNeil* core, and substrate monitoring is expected to be initiated 1 year postharvest and would occur once a year if one of the action alternatives is selected. Postharvest fish habitat and large-woody-debris monitoring is expected to be initiated within 5 years postharvest and would occur once a year during base flow periods if one of the action alternatives is selected. Postharvest riparian stand and shade monitoring is expected to be initiated 1 year postharvest and would occur once a year if one of the action alternatives is selected. Postharvest stream temperature monitoring is expected to be initiated 1 year postharvest and would occur once a year from spring to fall if one of the action alternatives is selected. If one of the action alternatives is selected, DNRC intends to conduct the anticipated project-level monitoring; funds for the monitoring are included in the DNRC budget. DNRC is a signatory to the *Restoration Plan for Bull Trout in the Clark Fork River Basin and Kootenai River Basin, Montana*, of which, the *Land Management Report (MBTSG 1998)* is a supporting appendix. DNRC continues to consider the *Restoration Plan* a very valuable and notable planning guide of bull trout conservation goals when considering land-management activities in bull trout watersheds. However, even though DNRC makes best efforts to adapt to the proposed strategies in the *Land Management Report*, the proposed strategies are nonetheless “recommendations” only. The anticipated monitoring (detailed above) is designed to be both validation and effectiveness monitoring. The anticipated monitoring is validation monitoring since the monitoring results will test many of the risk and impact assessments made in the effects analysis of *APPENDIX E – FISHERIES*. Although the anticipated monitoring does not explicitly tier to the “criteria” in the *Land Management Report* in terms of effectiveness monitoring, the “criteria” for the *Land Management Report* indices that would be analyzed as part of the anticipated monitoring are generally analogous to those made in the risk and impact assessments for fisheries. For instance, the potential impacts to fisheries resources in bull trout streams are expected to range from negligible to low, with “low” meaning effects may be detectable or measurable, but those effects are not likely to be detrimental. The “criteria” for the *Land Management Report* indices that would be analyzed as part of the anticipated monitoring are described as “no measurable detrimental change” or “maintain”. To summarize, the anticipated monitoring does not explicitly tier to the “criteria” in the *Land Management Report*, but the anticipated monitoring will address most of the *Land Management Report* indices using complementary parameters. Of the 20 indices that address the 8 habitat components in *Table 3* of the *Land Management Report*, the anticipated monitoring will be able to directly analyze 14 of the indices that address 6 habitat components. The two habitat components that are not addressed by the anticipated monitoring are connectivity and chemical water quality. Connectivity would not be monitored in bull trout streams in the project area since there would be no impacts to this habitat component. In order to accurately convey DNRC commitments to interagency bull trout monitoring efforts, the reason that ‘fine sediment’ and ‘redd counts’ are routinely done by DFWP (throughout Swan River State Forest) is because DNRC routinely pays DFWP to conduct such monitoring. These annual monitoring commitments are just one part of DNRC’s commitments to larger interagency efforts (including the *‘Restoration Plan’, Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program,* and *Swan Valley Bull Trout Work Group*) to support regional bull trout research and conservation efforts.

    The *Land Management Plan* states: “Land management activities are not categorically prohibited or restricted within these caution zones by this strategy. However, because activities that occur within the caution zone inherently pose some risk, they should not occur unless monitoring occurs or sufficient information is available to reliably demonstrate that the activity

will not adversely affect the habitat components." (*MBTSG 1998*) As cited above, "land management activities are not categorically prohibited or restricted within these caution zones by this strategy", and DNRC has chosen to implement the *Administrative Rules of Montana* (*ARM*). In this case DNRC is required to implement a fisheries riparian management zone on fish-bearing streams (*ARM 36.11.425*) in order to adequately protect important fisheries habitat components. Furthermore, this decision also satisfies the framework for conducting land-management activities in the "caution zone" since supplemental analysis has been conducted for the DEIS and an anticipated monitoring plan has been developed. The DEIS provides a thorough analysis of potential impacts, and, consequently, sufficient information that reliably demonstrates that the proposed activities are not expected to have detrimental effects on habitat variables in bull trout streams. The analysis relies on both data from past projects and outputs from peer-reviewed models. The DEIS also provides a list of anticipated monitoring. DNRC has chosen to implement the Administrative Rules of Montana. In this case DNRC is required to implement a fisheries riparian management zone on fish-bearing streams (*ARM 36.11.425*) in order to adequately protect important fisheries habitat components. The fisheries riparian management zone is established in conjunction with and adjacent to the Streamside Management Zone (*ARM 36.11.311, 36.11.312*). Streamside Management Zones are delineated at the stream edge using the "ordinary high water mark", which corresponds with those points delineating the bankfull edge of the stream. Data from past projects on Swan River State Forest is not required in order to reliably demonstrate that the proposed land-management activities are not expected to adversely affect the habitat components. The text from the *Land Management Report* states: "Land management activities are not categorically prohibited or restricted within these caution zones by this strategy. However, because activities that occur within the caution zone inherently pose some risk, they should not occur unless monitoring or other sufficient information is available to reliably demonstrate that the activity will not adversely affect the habitat components." (*MBTSG 1998*) Again, the FEIS provides a thorough analysis of potential impacts, and, consequently, sufficient information that reliably demonstrates that the proposed activities are not expected to have detrimental effect on habitat variables in bull trout streams. The analysis relies on both data from past projects and outputs from peer-reviewed models. Some of the data that takes into account the potential impacts of past projects on and adjacent to Swan River State Forest that are included in the DEIS analysis are: redd counts, *McNeil* cores, substrate scores, Wolman pebble counts, fish habitat variables such large woody debris frequency, pool volume and frequency, and stream temperature.

32. The DEIS analysis delineates a 95-foot buffer on South Fork Lost Creek that includes 25 feet of no harvest close to the stream and 70 feet of adjacent partial harvest away from the stream. The DEIS analysis delineates an 83 foot buffer on Soup Creek that includes 25 feet of no harvest close to the stream and 58 feet of adjacent partial harvest away from the stream. The DNRC analysis finds that the 95-foot and 83-foot buffers described here are expected to be effective management prescriptions to prevent detrimental impacts to habitat variables in bull trout streams. However, in order to mitigate for potential adverse impacts to terrestrial wildlife, the actual management prescriptions on bull trout streams are expected to increase the partial harvest portion of the buffers to 75 feet, which will create 100-foot buffers. Therefore, the actual potential risks and impacts to bull trout habitat variables may be less than those outlined in *APPENDIX E – FISHERIES*. A 25-foot no-harvest buffer alone might be weaker than the best available data suggests for adequately protecting most aquatic species. However, DNRC does not propose to utilize only a 25-foot no-harvest buffer. (See comment response above.) The Inland Native Fish Strategy only applies to federal land-management activities on Forest Service land. The plan does not apply to land-management activities on State trust lands. The *USFWS Bull Trout Interim Conservation Guidance* was developed for use by the USFWS. So that the statement above is not taken out of context for readers, the text at the beginning of the document states: "[The Bull Trout Interim Conservation Guidance] is not intended to provide site specific land management prescriptions, but to provide recommended actions that may be adapted and

modified to benefit bull trout in a particular locale."

This comment is addressed through several different responses above.

33 Will all of them be reclaimed or just some? Will other roads be reclaimed? What is the timing of this road work and how does it cumulatively impact these important bull trout streams?

While the bridge removals may be considered "mitigation" they still have a cumulative effect from operating equipment in the stream and from sediment that may enter the stream from the fill behind the bridges. There needs to be a thorough cumulative effects analysis of the bridge removals, new road construction, road upgrades and the continued existence of an unmaintained South Lost Creek road on bull trout and bull trout habitat.

34 • The DEIS does not disclose whether the South Lost Road that is relocated will be permanently or hydrologically reclaimed or will just be made impassable and left in place to deteriorate into South Lost Creek. Another road will be built upslope on sensitive soil types. From a terrestrial species standpoint you may consider blockading the road to be sufficient (we do not) but from a watershed standpoint you are increasing road densities and road impacts on a bull trout spawning stream. We are not arguing that the current South Lost Creek road is in a good location, or in good shape. However, just abandoning the current road and building another does not solve the problem that the current road is causing to the stream.

35 • The project area is designated critical habitat for bull trout. DNRC should be taking every precaution not to adversely modify bull trout habitat, instead this project delineates skimpy buffers and does not disclose or analyze the short-term or cumulative sediment impacts.

36 • The South Lost and Cilly Creek roads are FRTA cost share roads with the Forest Service. DNRC must consult on the effects to bull trout critical habitat and must conference on the effects to proposed lynx critical habitat from re-building the South Lost Road and any other roads associated with the FRTA agreement.

37 • DNRC is implementing some questionable strategies contained in the draft conservation strategies for the Habitat Conservation Plan prior to completing the HCP. This could result in take of threatened and endangered species.

38 <u>Soils</u>

• This project has numerous cutting units on Landtypes 73, 75 and 76. The Flathead National Forest Plan describes Landtype 75 as "not capable of commercial timber management, surface occupancy or permitted domestic livestock use due to the steepness of slope, exposed rock and lack of soil." Landtype 73 and 76 hazard reduction and site preparation is expensive due to steep slopes, south slopes have low vegetative productivity and are difficult to revegetate. What is the growth and yield rate of previously logged units on these soil types in the project area? How does DNRC intend to regenerate trees on these sites that even the Flathead National Forest knows have low vegetative productivity and are difficult to revegetate? If these slow-regenerating sites are being used in assumptions regarding wildlife habitat then the entire wildlife analysis is flawed.

DNRC Response

33. The *DEIS* discloses the estimated short-term impacts of removing old bridges, upgrading of roads, and relocating South Lost Road from the streamside on *Pages III-29* through *III-33*, and *Pages D-9* and *D-10*; and in the FEIS on *Pages III-29* through *III-32* and *D-9* through *D-11*. The *DEIS* lists and describes each of the proposed stream crossing replacements and proposed new stream crossing installations, along with a description of their locations on *Pages D-9* through *D-18.* These discussions can also be found in this FEIS on *Pages D-9* through *D-18*. The proposed roadwork involving CMP installations or replacements would be contained in 3 contracts, and the number of these projects is dependent on the selected alternative. Construction on these contracts would be managed by timing constraints set down in the Stream Preservation Act (124) Permit process and may lead to simultaneous operations. However, as stated in the *DEIS* on *Pages D-18* through *D-22*, all applicable recommendations given in the 124 and 318 permits would be followed, and no limits set forth in State water-quality laws would be exceeded. The expected impacts to fish habitat from sediment are disclosed for all proposed activities in the *DEIS* on *Pages E-57* through *E-66*, and in this FEIS on *Pages E-56* through *E-66*. All temporary roads would be decommissioned to a condition where they permanently meet all applicable BMPs, require no maintenance, and would not be a risk to water quality or erosion. As stated in the *DEIS* on *Page III-29* and *Pages D-9* through *D-18*, temporary roads would be decommissioned immediately following the completion of activities in the proposed units, and portions of South Fork Lost Creek Road would be decommissioned under all proposed action alternatives. The timing of all proposed roadwork at stream crossings and where fish habitat may be impacted would be timed according to stipulations and specifications called for by the DFWP through the 124 Permit process. All timing and mitigation measures will be discussed and approved prior to starting these proposed activities. The cumulative effects of the proposed action alternatives, including proposed roadwork and stream crossings, are displayed in the *DEIS* on *Pages E-91* through *E-97 and* in this FEIS on *Pages E-91* through *E-96*.

    The *DEIS* does not refer to the proposed bridge removals as “mitigation”, but as rehabilitation measures. The purpose of the bridge removals is to rehabilitate sites where sediment delivery is either occurring, or is at a high potential to occur with further decay of the existing structures. The cumulative effects to sediment delivery of all proposed action alternatives is displayed in the *DEIS* on *Pages D-18* through *D-24*, and in this FEIS on *Pages D-19* through *D-25*. The expected impacts to fish habitat from sediment are disclosed for all proposed activities in the *DEIS* on *Pages E-57* through *E-66*, and in this FEIS on *Pages E-56* through *E-66*.

34. The *Forest Roads and Trails Act (FRTA) Agreement* completed between the FNF and DNRC in 2002, and the *Cost-Share Agreement* between the FNF and DNRC in 2003 detailed the proposed and agreed-upon measures to rehabilitate the sections of South Fork Lost Creek Road proposed for replacement. These were analyzed for in the *Biological Opinion* and deemed appropriate by all parties in the Agreement, and would be implemented under any selected action alternative of the Three Creeks Timber Sale Project FEIS. The methods of reclamation for South Lost Creek Road include a range of designs from laying portions of the road prism back to slope, relieving compaction to allow water infiltration, and scarifying the surface and placing rocks. Logs and slash would make the old roadbed impassable. All levels of reclamation would provide for erosion control, sediment filtration, surface drainage and short- and long-term revegetation. No portion of the reclaimed South Fork Lost Creek Road would need maintenance following reclamation activities. The proposed new location for South Fork Lost Creek Road would locate the new road on the same landtypes as the current segments proposed for abandonment. The proposed new location would simply move the road farther from the South Fork Lost Creek and reduce the risk of sediment delivery to the stream from the road. The FNF soil survey does not list any of the soil types in the proposed road relocation as a high risk for mass movements or as an unstable soil type. Road densities and road impacts to bull trout spawning streams are addressed in *APPENDIX F – FISHERIES ANALYSIS* of the *DEIS* and this FEIS. The methods of reclamation for South Fork Lost Creek Road include a range of designs from laying portions of the road prism back to slope-relieving compaction to

allow water infiltration, and scarifying the surface and placing rocks, logs, and slash to make the old roadbed impassable. All levels of reclamation would provide for erosion control, sediment filtration, surface drainage and short- and long-term revegetation. No portion of the reclaimed South Fork Lost Creek Road would need maintenance following reclamation activities.

35. The ‘project area’ is not designated ‘critical habitat’ for bull trout. Certain reaches of South Fork Lost and Soup creeks that are designated as critical habitat do flow through the project area. DNRC is taking all reasonable and practical precautions to not adversely modify bull trout habitat in South Fork Lost and Soup creeks. The *DEIS* analyses describe the proposed actions associated with each alternative and anticipated positive and negative effects of those proposed actions to bull trout habitats. The detailed DEIS analyses describe “low” impacts that may occur to some variables of bull trout ‘critical habitat’ in the project area; however, “low” impacts mean the effects may be detectable or measurable, but those effects are not likely to be detrimental. In this regard, a potential “low” impact is extremely different from an “adverse modification” impact, which would correspond to a “high” impact in the detailed *DEIS* analyses (see *DEIS Pages D-2, E-7* and *E-51* and this FEIS, *Pages D-2 and D-3, E-6 and E-7,* and *E-50*). We interpret “skimpy” buffers to mean that the proposed buffers are “inadequate or lacking in size. The size of the proposed buffers on South Fork Lost and Soup creeks are described above in the response to comment: “The DEIS delineates a mere 25 foot no harvest buffer on key bull trout spawning streams without providing any science to support it.” The *DEIS* analysis describes the potential impacts to bull trout habitats as a result of implementing the proposed buffers in *APPENDIX E – FISHERIES*. The anticipated short-term impacts from sediment related to the proposed actions are described in the *DEIS, Pages D-9, D-10, E-57, E-60, E-62,* and *E-65*, and in this FEIS *Pages D-9, D-10, E-56, E-59, E-61,* and *E-63*. The anticipated cumulative impacts, including the impacts from sediment, are described in the *DEIS, Pages D-18* through *D-24* and *E-91* through *E-95*, and in this FEIS, *Pages D-19* through *D-25* and *E-91* through *E-96*. Furthermore, as ‘critical habitat’ regulations do apply to federal nexus situations, the short-term and cumulative impacts related to sediment are detailed in the federal environmental analyses related to the proposed relocation of the cost-share road segment adjacent to South Fork Lost Creek (see comment response immediately below.)

36. DNRC and FNF completed the *FRTA* package in 2002, and the *Cost-Share Agreement* between the FNF and DNRC was completed in 2003. Consultation with FNF and USFWS began in 1999, and the *Biological Opinion* was issued in 2001 regarding the proposed relocation of the South Lost Creek Road. The agreements made under those negotiations would be fully implemented under any action alternative of the Three Creeks Timber Sale Project FEIS.

37. DNRC is in the process of developing a Habitat Conservation Plan for bull trout, which would apply to most forested State trust lands, including those in the proposed Three Creeks Timber Sale Project area. DNRC is not implementing conservation strategies proposed for the Habitat Conservation Plan in the proposed Three Creeks Timber Sale Project because the Habitat Conservation Plan has not been completed. Although the proposed prescriptions in *APPENDIX E – FISHERIES ANALYSIS* are similar to the conservation strategies proposed for the *Habitat Conservation Plan*, the proposed riparian prescriptions in *APPENDIX E – FISHERIES ANALYSIS* are an application of *ARM*. In this case, DNRC is proposing to implement a fisheries riparian management zone on fish-bearing streams (*ARM 36.11.425*), which has been designed to avoid detrimental impacts to the habitat components of bull trout, a “threatened” species. Furthermore, the proposed riparian prescriptions in *APPENDIX E – FISHERIES ANALYSIS* greatly exceed the requirements established for Streamside Management Zones (*ARMs 36.11.311, 36.11.312*).

38. According to forest-improvement surveys in old harvest units within and near the proposed project area, all stands are fully stocked with trees with the exception of portions of harvested stands in the Cliff Creek portion of the project area. Stands here are partially stocked, and trees are actively growing in all previously harvested stands. Stands not fully stocked within the project area

are all found in the Cliff Creek drainage, and are found on several different landtypes. Stand regeneration plans are discussed in the *DEIS* on *Pages II-4* through *II-10*, *Pages III-5* through *III-8,* and *Pages C-13* through *C-17*. More detailed stand-by-stand regeneration plans are included in stand prescriptions, which are part of the Timber Sale Contract.

For responses to the growth and yield proportion of this comment refer to response #2 above.

39 • The DEIS contains misleading information regarding how schools are actually funded. In the South Wood Project file a DNRC memo acknowledged that the economic analysis, as it relates to classroom benefits is not accurate, yet the Three Creeks DEIS still contains this inaccurate information. For example, Action Alternative B is estimated to produce slightly more than $3,459,900 which would purportedly produce enough revenue to send 489 students to school for 1 year without any financial support. (see page H-4) DNRC knows that trust revenue only supplies a small portion of total school funding and the legislature adjusts school funding from the General Fund to make up any difference. Furthermore, an economic analysis that only discusses the revenue and not the costs and further states that this revenue will educate 489 school children without subtracting the costs is misleading.

40 • The DEIS failed to analyze opportunity costs or compare what the rate of return would be if the costs for this sale were invested in something else. In other words, what is the next best use for investing that money?

41 Range of Alternatives

• The DEIS did not analyze a range of alternatives as required by the Montana Environmental Policy Act. All four action alternatives construct many miles of new and temporary roads which fragment old growth habitat and/or cross streams, all log in old-growth forest habitat, all log along bull trout spawning streams, all log between 22 and 26 million board feet of timber and all log with regeneration harvest methods.

We expect that our comments and concerns be addressed in the Final EIS.

Sincerely,

Arlene Montgomery
Program Director

DNRC Response

39. The DEIS contains no information on the funding of schools, only on the estimated amount of net revenue the "treatments" identified in the alternatives will provide to support Montana's school trusts. How schools are funded is a broader question, outside the scope of this EIS and primarily the responsibility of the Office of the Governor, Office of Public Instruction, and other trust beneficiary governing institutions.

    The response in the South Wood file appears to be in response to a statement indicating a direct correspondence between the number of students funded and the revenue from a timber sale. The *DEIS* makes no such linkage, but does establish a correspondence or equivalence between the net revenue from the timber harvests and the cost of educating a single student for a year. Nowhere does it state that these sale monies will go directly to the schools or that all of the money will be spent directly on students. The requirement from the "*Enabling Act of 1889*" is that the money be used for the "support of schools." Modifications to the *DEIS* will be made to ensure this relationship is clear.

    The amount of school funding provided from trust lands generally varies between 4 and 10 percent of the kindergarten through grade 12 school budget, depending on whether both State and federal monies are included and the resources prices in any given year, amongst other things. There is no requirement that the trust monies cover all of the school expenditures, only that the earnings from trust lands be used to support schools. This is what is occurring; trust earnings are identified for education, additional funds are provided from other sources to provide the overall level of educational support established by the legislature and the governor. As stated in the DEIS, if the trust earnings were not available to support the schools, the money would have to come from taxes or other similar source, other programs would need to be cut in order to provide funding at the current level, or the educational budget would need to be cut in order to "balance the budget."

    The economic analysis does discuss costs based on the average level of expenditures associated with timber sales (*TABLE H-3*). Because of the large size of this project, these costs are likely to be higher than the actual costs, which cannot be known until the sale is completed. Statewide timber sale revenue in FY 2005 exceeded costs by a factor of over 2 to 1. All estimates of equivalent education of school children are based on estimated net revenues, not gross revenues.

40. With a State-wide rate of return of over 2 to 1, the rate of return on costs is over 100 percent. Only the most speculative, risky investments earn similar rates of return. This level of risk cannot be justified based on the level of return being earned on costs of managing State trust assets. Since the disposal of the land is difficult due to laws and other influences on the Bureau, analyzing the returns on earnings from selling the land seemed inappropriate, particularly since it did not relate to proposed actions within the *DEIS*.

41. DNRC believes that we have presented an adequate range of alternatives by analyzing 4 action alternatives and a no-action alternative. Each alternative is unique in terms of stands treated and volume harvested, as well as in the level of road building and amount of harvesting in old growth. Action Alternative E was designed specifically to reduce the amount of harvesting in old-growth areas and minimize road building (*DEIS*, *Page II-10* and this FEIS, *Page II-10*). *ARM 36.2.529 (5)* requires "an analysis of reasonable alternatives to the proposed action, including the alternative of no action and other reasonable alternatives…." Accordingly, *ARM 36.2.522 (2)(b)* requires the Agency "to consider only alternatives that are realistic, technologically available, and that represent a course of action that bears a logical relationship to the proposal being evaluated." We feel that through the alternative-development process, we have addressed the concerns of the public and have developed alternatives that meet the tenets of the *SFLMP* and *Administrative Rules for Forest Management* (*ARM 36.11.401* through *36.11.450*). Each action alternative was designed to meet the overall project objectives (*DEIS, Page I-2* and this *FEIS, Page I-2*). As described in the *DEIS*, 2 additional alternatives were considered, but not analyzed in detail because preliminary analysis showed the project objectives would not be met (*DEIS, Page II-20* and this *FEIS, Page II-22*).

MONTANA ENVIRONMENTAL INFORMATION CENTER

"Working to Protect and Restore Montana's Natural Environment Since 1973"

October 5, 2006

OPTIONAL FORM 99 (7-90) FAX TRANSMITTAL		# of pages ▸ 2
To Karen	From David Groeschl	
Dept./Agency DNRC	Phone #	
Fax # 754-2884	Fax #	
NSN 7540-01-317-7368 5099-101	GENERAL SERVICES ADMINISTRATION	

Karen Jorgenson
Swan River State Forest
34925 Highway 83
Swan Lake, Montana 59911

Via
David Groeschl
Fax: 406-542-4217

Dear DNRC:

The Montana Environmental Information Center is extremely concerned about the Draft Environmental Impact Statement on the proposed Three Forks Timber Sale Project in the Swan River State Forest. We would like to incorporate by reference the comments submitted by Jane Adams with the Montana Old Growth Project. Since the email and fax number for submitting comments was not provided in the DEIS or on the Trust Land Management Division's web site, I am submitting these comments directly to Mr. Groeschl with the assumption that he will forward them to Karen Jorgenson.

For many years MEIC advocated the development of rules for the management of old growth forests on state school trust lands. After years of debate, the state adopted such rules. The adoption of these rules was a huge accomplishment for the state. Finally citizens had meaningful language they could rely upon to ensure that forests were managed for long-term as well as short-term environmental benefit and economic gain.

In addition, MEIC argued against the increase in the annual sustained yield because it was apparent that increasing the annual cut would not be sustainable. Instead it would only result in short term profit at the expense of long-term management goals.

Now, due to the increase in the annual sustained yield, it appears that DNRC is proposing one of the largest timber sales in state lands history with much of the timber coming from old-growth forests. This sale will provide approximately one-half of the required annual cut from one area. Regardless of whether this is broken up into two or three years, it is still a disproportionate share of timber coming from one small, yet ecologically important area.

The analysis provided in this document understates the historical quality and ecological importance of old growth forests in the Swan River State Forest. As Jane Adams stated, much research was ignored or failed to be carried through in the analysis on historic conditions of old growth in the area of the timber sale. The rules rely on the veracity of this data. Using incomplete

DNRC Response

The fax number was on the cover letter in the bottom right-hand corner, but will be included on the back cover of the FEIS along with an e-mail address.

DNRC disagrees with the commenter's assertions. The expected condition is that current and historical stands of similar composition growing on similar sites will develop similar age-class distributions. Rationale is presented in the age-class (*Pages C-9 through C-19*) and old-growth analysis (*Pages C-37 through C-60*) sections of the *DEIS* and further explained in responses to Montana Old Growth Project's questions 3, 4, 5, 6, and others. Also, DNRC has repeatedly and consistently applied its intention from the *SFLMP* and *ARM* that it will not commit to providing additional habitat or stand conditions on its land simply because another landowner has removed that component from their land. Although *ARM* does not rule out extending that concept to the flip side, DNRC also does not currently rely on mitigations provided by the nearly 2 million acres of federally designated wilderness that are in close proximity to the project area to lessen the effects of our activities on the land we manage. The commitment from the *SFLMP* and *ARM* is as follows:

> *36.11.407(3): The department shall design timber harvests to promote long-term, landscape-level diversity through an appropriate representation of forest conditions across the landscape as described in ARM 36.11.404. Where state ownership contains forest conditions made rare on adjacent lands by the management activities of others, the department may not necessarily maintain those conditions in amounts sufficient to compensate for their loss when assessed over the broader landscape, except as it coincides with other agency objectives.*

Please refer to response #41 that pertains to the comment letter from Friends of the Wild Swan.

or inaccurate information distorts the entire analysis. The analysis should be completely revamped and should reflect the true historic conditions, not be geared toward reaching the desired outcome of harvesting large quantities of old growth in one of the most ecologically important regions of the state.

The range of alternatives is inappropriate. It provides no real variability in the number of acres to be harvested. Stands with previous heavy harvesting are considered old growth. Fragmentation was inappropriately analyzed to skew the results. In short, the rules require that DNRC manage forests in a manner "based on the patters historically present on the landscape as a result of natural disturbances." ARM 36.11.418 (1) This timber sale is based on faulty assumptions and flawed logic. It does not move toward historic conditions, but away from them.

We urge you to pull this DEIS and properly analyze old growth forests in the Swan River State Forest. Until that analysis is complete, DNRC should not move forward with this timber sale.

Sincerely,

Anne Hedges

Anne Hedges
Program Director

Montana Wood Products Association

MONTANA
Wood Products
ASSOCIATION

Date Rec'd
10.2.06 W

September 27, 2006

Karen Jorgenson, Project Leader
Swan River State Forest
34925 MT Highway 83
Swan Lake, MT 59911

Re: Three Creeks Timber Sale Project DEIS

These brief comments are provided on behalf of the 17 member companies and 40 associate members of the Montana Wood Products Association. All of these companies and individuals rely on the health of Montana's timber industry for their livelihoods.

The MWPA supports Alternative D in the DEIS for a number of reasons. This alternative harvests the greatest amount of timber at 25.8 mmbf thus generating the largest amount of revenue for the trust at approximately $3.5 million. This alternative also would build, reconstruct and perform maintenance on the most amount of road and would open more area for public access.

Timber would be harvested from 1,970 acres with commercial thinning occurring on 560 of those acres. Harvest would occur on 1,143 acres of old growth with 547 continuing to be classified as such while the remainder would no longer meet the old growth definition.

The downside to the selection of Alternative D is the use of helicopter logging, the most expensive method of harvest. The MWPA encourages the use of conventional ground based equipment and skyline cable systems wherever possible to minimize costs.

Long-term management objectives will best be met by use of Alternative D. Some of the roads in the area are open year round to all users and improvements, including a bridge crossing on Soup Creek, would enhance the use by the public. In addition, six older stream crossings in various stages of collapse would be rehabilitated under this proposal.

A much needed improvement to a section of the South Fork of Lost Creek Road would also occur by moving the road about 200 feet north and away from the streamside management zone. There would also be streambank stabilization of several locations.

DNRC Response

All new road construction and maintenance that occurs within restricted road systems will be open to nonmotorized public use and winter snowmobile access *only*. The roads are being constructed and improved for timber harvesting, log hauling, and administrative use.

During the planning process, the best available information and ground reconnaissance were utilized to determine harvesting methods. All action alternatives propose helicopter logging in areas where excessive road-construction costs, steep terrain, resource-damage concerns, and limited skyline cable deflection prevents other harvesting method opportunities.

The FEIS has been altered to note that the action alternative area maps have 200-foot contours. This alteration should clarify that some helicopter logging areas are not readily apparent upon viewing the existing DEIS maps.

Five of the six older stream crossings, including the two on Lower Soup Creek, all involve bridge removal and site rehabilitation. The sixth crossing, on Upper Soup Creek, will have a temporary bridge placed for timber harvesting, log hauling, and postharvest administrative use only. Ultimately, the temporary bridge will be removed as well. Therefore, all of these rehabilitation activities will enhance only nonmotorized use.

Montana Wood Products Association

The entire project area has varying amounts of insect and disease activity. The proposed harvest treatments would remove trees affected by insects and disease. With the longer term management objectives, losses would be reduced and stand susceptibility would be decreased thus improving the health of the forests.

An expanded road system would provide greater access to the Montana public, but would also aid in wildfire suppression efforts should the need arise.

Thank you for the opportunity to present these comments. Please keep the MWPA on any communication lists regarding this project.

Sincerely,

Ellen Engstedt

Ellen Engstedt
Executive Vice President

cc: MWPA Board of Directors

Sherman

Date Rec'd
9.20.06

September 20, 2006

Karen Jorgenson
Swan River State Forest
34925 Hwy 83
Swan Lake MT 59911

Dear Karen:

Enclosed are my comments on the Three Creeks timber sale DEIS.

It is my opinion that the design of all alternatives do not exhibit much diversity in acres cut, the amount or volume taken, old growth cut and many miles of roads built. I am opposed to the extreme amount of roads that will be built and the amount of old growth that is to be cut. I am also concerned with unsustainable HIGH yield of 53.2MMBF. It seems to me that the cutting of this large volume, only to reach an arbitrary board feet amount, is backwards forest management and that this is out of the classification of sustainable and into the classification of gluttony.

As to old growth, the SRFS now has far less old growth than the historical past. When you state that maintaining or increasing the amount of old growth moves the situation further from the historical past you are in contradiction of what science has shown us was the case; ie Losenskys estimate of old growth in SRSF of 74% a fact not mentioned in your DEIS.

In fact I feel all proposed alternatives create conditions that take this forest away from what you call historically significant. All old stands would be internally weakened from historic conditions Thus you lose integrity of wildlife habitat, forest health and this further impacts areas which have not been managed properly in the past.

On a side note, in my research of schools (for example Columbia Falls) presently receive a small, ear marked percentage from school trust timber sales, approximately $60,000. I also question why the DNRC allows trapping of wildlife on state lands. It does nothing for economic benefit of schools and is indiscriminate of what animals, i.e., **Lynx**, are killed or trapped.

I would ask that you return to an alternative that does not impact the forest as all alternatives demonstrate they will do and GOOD FOREST STEWARDSHIP is replaced by large targeted voluminous cuts that are not sustainable.

Thank you,

Roger Sherman

Roger Shrman
6203 Monterra Ave
Unit H
Whitefish MT 59937

DNRC Response

1. DNRC believes that we have presented an adequate range of alternatives by analyzing 4 action alternatives and a no-action alternative. Each alternative is unique in terms of stands treated and volume harvested, as well as in the level of road building and the amount of harvesting in old growth. Each action alternative was designed to meet the overall project objectives (*DEIS, Page I-2* and this *FEIS, Page I-2*). As described in the DEIS, 2 additional alternatives were considered, but not analyzed in detail because preliminary analysis showed that they would not meet the project objectives (*DEIS, Page II-20* and *FEIS, Page II-22*). One of the objectives is to provide volume toward DNRC's annual sustained yield, which was calculated in 2004.

2. Please refer to DNRC's responses to Montana Old Growth Project's comments #4 and #11.

3. The State is obligated to use the revenues from all trust land resources for the "support" of schools and other designated institutions. There are 10 trust beneficiaries, including Public Building, that benefit from State trust land revenues. The revenue is transferred from DNRC to the appropriate agency in accordance with laws and rules established by the *Enabling Act of 1889*, *Montana Constitution*, Montana State Legislature, and Governor. The allocation of funds to an individual school is made within this framework. The actual distribution of the money is from the Office of Public Instruction for Public Schools (kindergarten through grade 12). The amount of school funding provided from trust lands State-wide generally varies between 4 and 10 percent of the kindergarten through grade 12 school budget, depending on whether both State and federal monies are included and the on the resource prices in any given year. The trust land revenues are not sufficient to cover all school expenditures, but are part of the mix of funding for kindergarten through grade 12. There is no requirement that trust monies cover all of the school expenditures, only that the earnings from trust lands be used to support schools or other designated institutions.

4. The coarse-filter analysis on *Pages F-2* through *F-23* of the *DEIS* describes the effects to wildlife habitat. Trapping is a legal method to take wildlife species in Montana. As such, DFWP regulates trapping methods and quotas for wildlife species. Since trapping is a legal method of taking wildlife species and a legal recreational activity, trapping is allowed on State trust lands. Because DNRC manages these lands for the trust beneficiaries, a fee is charged for their use. In 2002, the legislature approved an additional $2 fee on each Conservation License to be used for access to State school trust lands for hunting, fishing, and trapping purposes (*State Statute [§] 77-1-815*). This fee generates approximately $900,000 annually. Ninety percent of the money raised by this fee is used to compensate the trust for recreational use, while the remaining 10 percent is distributed to DNRC for repair of lease improvements, weed control/ management, protection of the resource value, administration/management, and/or maintenance of roads related to the public recreational use of State trust land (*§77-1-808 MCA*).

Swan Lake Ranger District

United States Department of Agriculture

Forest Service

Swan Lake Ranger District
(406) 837-7500
Fax (406) 837-7503

200 Ranger Station Road
Bigfork, MT 59911

File Code: 1930/1620

Date: October 11, 2006

Daniel J. Roberson
Unit Manager
Swan River State Forest
34925 MT 59911

Date Rec'd
10-15-06 W

Re: Three Creeks Timber Sale Proposal

Dear Mr. Roberson,

Thank you for the opportunity to review and comment on your Three Creeks Timber Sale DEIS. The following comments and/or questions on your proposal are provided by the district planning team.

1. How does the proposed new road construction fit into the standards and guidelines of the Swan Valley Grizzly Bear Conservation Agreement? How many miles of permanent new roads would be constructed? How much, if any, of the proposed road construction would be temporary roads? Would temporary roads be reclaimed after their use?

2. The description of the proposed actions includes management actions to remove and replace bridges; however, it does not address the placement of a stream crossing where FDR #680 crosses Cliff Creek in Section 7, T24N, R17W. The Forest Service has removed the culvert at the Cliff Creek crossing, and the use of this cost-share road will require substantial road maintenance to support log hauling, including the placement of a bridge at the stream crossing.

4. In reviewing the watershed and hydrology analysis (Appendix D), it does not appear that the effects analysis included actions on NFS lands, such as the placement of the stream crossing on road #680.

5. Will the South Fork Lost Soup grizzly bear sub-unit be 'active' long enough to finish sale activities?

6. Your assessment indicates that effects to Canada lynx would be short-term. It appears that there could be long-term effects to lynx, if the units proposed for regeneration harvest are scheduled for pre-commercial thinning in the future.

7. The wildlife analysis summary indicates that enough thermal cover will remain for mule deer and elk, but does not address white-tailed deer. Thermal cover requirements for white-tailed deer are higher (requires more canopy cover) than for mule deer and elk. It appears that the potential effect to white-tailed deer winter habitat should be included in the wildlife analysis summary of the DEIS.

DNRC Response

1. The proposed road construction and management meets all the standards and guidelines in the *SVGBCA*. The total miles of new permanent and temporary roads by alternatives are found in *TABLE F-12* on *Page F-40*. Temporary roads would be made impassable and be abandoned following use. Details of road construction can be found in the *DEIS* on *Pages II-4, II-5, II-9, and II-10 through II-12*. *TABLE II-1* has been added to this FEIS that summarizes road construction information.
2. Thank you for the comment. The use and reconstruction of the Cliff Creek road system and its associated sediment delivery estimates are included in the values and mileages reported in the *DEIS*, *Pages III-32* through *III-33* and *Pages D-14* through *D-23*. The placement of a temporary bridge over Cliff Creek will be addressed in this FEIS.
3. Number 3 was skipped in the comment letter.
4. See #2 above.
5. Yes. This project, including timing restrictions, is designed to meet the *SVGBCA* stipulations.
6. The assumption of sapling stands providing snowshoe hare habitat is appropriate. The vegetation analysis does not indicate that regeneration would be problematic. Whether regenerating stands undergo precommercial thinning would be determined at a future date. Therefore, the timing and precommercial thinning prescription are beyond the scope of this analysis and would be considered under a separate environmental analysis at the appropriate time.
7. The Three Creeks Timber Sale Project area does not provide designated winter range for white-tailed deer (*DEIS, Pages III-58* and *F-51*); therefore, effects of thermal-cover reduction on white-tailed deer was not considered.
8. MEPA requires analysis of the cumulative effects of past, present, and future actions. Past and present activities on other lands within the subunit were incorporated into the existing condition. Plum Creek Timber Company and USFS do not have timber sale projects planned for this subunit during the active period

8. The cumulative effects analysis of past, present, and reasonably foreseeable management actions appears to be limited to DNRC lands. Depending on the analysis area identified by your resource specialists for their resource areas, there may be NFS and/or privates lands within the analysis area that should be considered in the cumulative effects analysis. An example of this is the wildlife cumulative effects analysis area, which included the entire South Fork Lost Soup grizzly bear subunit; within the subunit, there are approximately 7 sections of NFS and 1 section of private lands.

Thanks again for the opportunity to comment on your Three Creeks Timber Sale Project DEIS.

Sincerely,

Steve Brady

STEVE BRADY
District Ranger
Swan Lake Ranger District

DNRC Response

(*DEIS, Page F-38*). Therefore, no foreseeable future actions on other ownerships within the analysis area were considered.

QuickTime™ and a Photo - JPEG decompressor are needed to see this picture

Swan View Coalition

"People Helping People Help the Earth"

3165 Foothill Road, Kalispell, MT 59901

406-755-1379 www.swanview.org

October 5, 2006

Swan River State Forest
Attn: Karen Jorgenson
34925 Hwy. 83
Swan Lake, MT 59911

Via e-mail to: kjorgenson@mt.gov

Dear Ms. Jorgenson;

Please accept the following comments on the Three Creeks Timber Sale Project on behalf of Swan View Coalition.

We have read the October 5, 2006 comments submitted in this matter by Arlene Montgomery on behalf of Friends of the Wild Swan. We concur with them and support Friends of the Wild Swan's findings. We incorporate Friends' comments by reference as our comments on the Three Creeks Timber Sale Project.

We have also read the September 16, 2006 comments submitted in this matter by Jane Adams on behalf of the Montana Old Growth Project. We concur with them and support Montana Old Growth Project's findings. We incorporate Montana Old Growth Project's comments by reference as our comments on the Three Creeks Timber Sale Project.

We ask to be kept informed of this project and to be invited to any field tours, open houses, or other public meetings that may occur in this matter.

Thank you for this opportunity to comment.

Sincerely,

/s/ Keith J. Hammer

Keith J. Hammer
Chair

DNRC Response

Thank you for your comments on the proposed Three Creeks Timber Sale Project. DNRC acknowledges your incorporation of others' comments by reference. Please refer to DNRC's specific responses to comments submitted by Friends of the Wild Swan and Montana Old Growth Project. We will keep you informed of the FEIS status and any events related to the project.

THREE CREEKS TIMBER SALE PROJECT
REFERENCES

Ake, K. 1994. Protocol paper: *Moving Window Motorized Access Density Analysis and Security Core Area Analysis for Grizzly Bear*. Unpubl. mimeo., 2/22/1995. Flathead National Forest, Kalispell, MT 10pp

Amman, G.D., McGregor, M.D., and Dolph, R.E., Jr. 1989. *Mountain Pine Beetle*. Forest Insect and Disease Leaflet 2 (revised). USDA Forest Service, Washington DC 11 pp

Aney, W. and R. McClelland. 1985. *Pileated Woodpecker Habitat Relationships (revised).* Pages 10-17 in Warren, N. eds. 1990. Old Growth Habitats and Associated Wildlife Species in the Northern Rocky Mountains. USFS, Northern Region, Wildlife Habitat Relationships Program R1-90-42 47pp

Antos, J.A., and Habeck, J.R. 1981. *Successional Development in Abies grandis (Dougl.)* Forbes Forests in the Swan Valley, Western Montana. Northwest Science, Vol. 55, No.1: 26-39

Ausband, D. 2004. *Snowshoe Hare Response to Precommercial Thinning in Northwest Montana: Final report to the Montana DNRC*. Forest Management Bureau, DNRC, Missoula, MT 19pp

Ayers, H.B. 1898. The Flathead Forest Reserve. Twentieth Annual Report, Part 5. pp 245-316

Ayers, H. B. 1899. Lewis and Clarke Forest Reserve, Montana. Twenty-First Annual Report, Part V, PL VIII pp 35-80

Bailey, R.G., P.E. Avers, T. King, and W.H. McNab, comps. and eds. 1994. *Ecoregions and Subregions of the United States.* Color map (1:7,500,000) and supplementary table of map-unit descriptions. USDA Forest Service and USGS, Washington, DC

Bartholow, J.M. 2002. *SSTEMP for Windows: The Stream Segment Temperature Model (Version 2.0)*. U.S. Geological Survey computer model and documentation

Baxter, C.V. 1997. *Geomorphology, Land-Use, and Groundwater-Surface Water Iinteraction: Aa Multi-scale, Hierarchical Aanalysis of the Distribution and Abundance of Bull Trout (Salvelinus confluentus) spawning*. Master's Thesis, University of Montana, Missoula, MT

Baxter, C.V., C.A. Frissell, and F.R. Hauer. 1999. *Geomorphology, Logging Roads, and the Distribution of Bull Trout Spawning in a Forested River Basin: Implications for Management and Conservation*. Transactions of the American Fisheries Society. 128:854-867

Beatty, J.S., G.M. Filip, and R.L. Mathiasen. 1997. *Larch Dwarf Mistletoe in* Forest Insect and Disease Leaflet 169. USDA Forest Service, Washington, DC. 7pp

Beschta, R., R. Bilby, G. Brown, L. Holtby, and T. Hofstra. 1987. Stream Temperature and Aquatic Habitat: Fisheries and Forestry Interactions. In: Salo, E. and T. Cundy (eds.). Streamside management: Forestry and Fishery Interactions. University of Washington, Institute of Forest Resources, Contribution No. 57. Seattle, WA

Bilby, R.E. and P.A. Bisson. 1998. *Function and Distribution of Large Woody Debris*. *In* River Ecology and Management: Lessons from the Pacific Coastal Ecoregion. Springer, New York, NY

Bosch, J. M. and Hewlett, J. D., 1982. *A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration.* Journal of Hydrology 55:3-23

Bower, J. 2004. *Trends in Large Woody Debris (LWD) Recruitment to Stream Channels in Western Montana (Draft)*. Unpublished. Department of Natural Resources and Conservation, Missoula, MT

Branine, A. 2006. Montana Department of Natural Resources and Conservation. Personal communication

Bull E.L. and J.A. Jackson. 1995. *Pileated Woodpecker: Dryocopus Pileatus.* The Birds of North America, American Ornithologists' Union, Washington DC 24pp

Bull, E.L., C.G. Parks, and T.R. Torgersen. 1997. Trees and Logs Important to Wildlife in the Interior Columbia River Basin. General Technical Report PNW-391. USDA Forest Service, Pacific Northwest Research Station, Portland, OR 55pp

Buskirk, S.W. and R.A. Powell. 1994. *Habitat Ecology of Fishers and American Martens*. Pages 283-296 *in* Buskirk, S.W., A. Harestad, M. Raphael, eds. Biology and Conservation of Martens, Sables and Fishers. Cornell University Press, Ithaca, NY

Byler, J.W. and S.K. Hagle. 2000. Succession Functions of Pathogens and Insects: Ecoregion Sections M332a and M333d in Northern Idaho and Western Montana. Summary. Region 1 FHP Report 00-09. USDA Forest Service, Northern Region, State and Private Forestry, Missoula, MT 37pp

Callahan, Paul. 2000. *Forest Road Sedimentation Assessment Methodology*. Land and Water Consulting, Inc.

Castelle, A. and A. Johnson. 2000. *Riparian Vegetation Effectiveness*. National Council for Air and Stream Improvement, Technical Bulletin No. 799

Currier, J. and D. Hughes. 1980. Temperature. In: An Approach to Water Resources Evaluation on Nonpoint Silvicultural Sources. EPA-600/8-80-12. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA

Department of Natural Resources (DNRC). 2003. Goat Squeezer Final Environmental Impact Statement. Montana DNRC, Swan Lake, MT. 418 pp

Department of State Lands, Idaho Department of Lands, USFS. 1996. Forest Insect and Disease Identification and Management

DNRC. 1996. State Forest Land Management Plan. Montana Department of Natural Resources and Conservation, Missoula, MT

DNRC. 1998. South Fork Lost Creek Supplemental Environmental Impact Statement. Montana Department of Natural Resources and Conservation, Swan Lake, MT. 182pp

DNRC. 2000. *State Forest Land Management Plan Implementation Guidance - Draft: Old-Growth Management on School Trust Lands*. Unpublished document, August 7, 2000. Missoula, MT. DNRC Forest Management Bureau. 72 pp

Dobson, A., K. Ralls, M. Foster, M.E. Soule, D. Simberloff, D. Doak, J.A. Estes, L.S. Mills, D. Mattson, R. Dirzo, H. Arita, S. Ryan, E.A. Norse, R.F. Noss, and David Johns. 1999. *Corridors: Reconnecting Fragmented Landscapes*. Pages 129-170 *in* M.E. Soule and J. Terbourgh, eds. Continental Conservation: Scientific Foundations of Regional Reserve Networks. Island Press, Washington, DC

Downs, C.C., R.G. White, and B.B. Shepard. 1997. *Age at Sexual Maturity, Sex Ratio, Fecundity, and Longevity of Isolated Headwater Populations of Westslope Cutthroat Trout*. North American Journal of Fisheries Management 17:85-92

Etheridge, D.E., and R.S. Hunt. 1978. *True Heartrots of British Columbia*. Pest Leaflet 55. Canadian Forestry Service, Pacific Forest Research Centre, Victoria, BC 10pp

FBC (Flathead Basin Commission). 1991. Final Report. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program, Kalispell, MT

Farns, P. 1978. *Hydrology of Mountain Watersheds, Preliminary Report.* Soil Conservation Service. Bozeman, MT

Ferrell, G.T. 1986. *Fir Engraver*. Forest Insect and Disease Leaflet 13. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. 8pp

Filip, G.M., P.E. Aho, and M.R. Wiitala. 1983 *Indian Paint Fungus: A Method for Reducing Hazard in Advanced Grand and White Fir Regeneration in Eastern Oregon and Washington*. Report R6-FPM-PR-293-87. USDA Forest Service, Pacific Northwest Region, Portland, OR. 24pp

Filip, G.M., and D.J. Goheen. 1984. *Root Diseases Cause Severe Mortality in White and Grand Fir Stands of the Pacific Northwest*. Forest Science 20:138-142

Fins, L., J. Byler, D. Ferguson, A. Harvey, M.F. Mahalovich, G. McDonald, D. Miller, J. Schwandt, and A. Zack. 2001. Return of the Giants. Station Bulletin 72. University of Idaho, Moscow 20pp

Fischer, R.A. and J.C. Fischenich. 2000. *Design Recommendations for Riparian Corridors and Vegetated Buffer Strips*. ERDC TN-EMRRP-SR-24: 1-17

Fisher, W.C., and A.F. Bradley. 1987. Fire Ecology of Western Montana Forest Habitat Types. USFS General Technical Report. INT-223

Foresman, KR. 2001. *The Wild Mammals of Montana*. Special Publication 12. American Society of Mammalogists. Allen Press, KS 278pp

Fraley, J.J., and B.B. Shepard. 1989. *Life History, Ecology and Population Status of Migratory Bull Trout (Salvelinus confluentus) in the Flathead lake and River System, Montana*. Northwest Science. 63 (4):133-143

Freedman, J.D., and J.R. Habeck. 1985. *Fire, Logging, and White-tailed Deer Interrelationships in the Swan Valley, Northwestern Montana*. In Fire's Effects on Wildlife Habitat Symposium Proceedings. Compiled by J.E. Lotan and J.K. Brown, USDA Forest Service Genral Technical Report INT-186. pp. 23-35

FWP. 1996. *White-tailed Deer Densities and Overall Distribution*. Kalispell, MT <http://fwp.mt.gov/insidefwp/gis/shapefiles/wtdden.shp.zip>

FWP. 1999. *Montana Elk Winter Ranges, Summer Ranges, Calving Areas, and Migration Areas*. Kalispell, MT <http://fwp.mt.gov/insidefwp/gis/shapefiles/elk99.shp.zip>

FWP. 2003. Montana Gray Wolf Conservation and Management Plan: Final Environmental Impact Statement. Montana Fish, Wildlife, and Parks, Helena, MT 420pp

FWP. 2004. *Mule Deer Distribution and Habitat*. Kalispell, MT <http://fwp.mt.gov/insidefwp/gis/shapefiles/muledr04.shp.zip>

Gamett, B. 2002. *The Relationship Between Water Temperature and Bull Trout Distribution and Abundance*. Master's Thesis. Utah State University, Logan, UT

Gibson, K. 2004. *Western Larch Mortality in Western Montana*. Report TR-04-11. USDA Forest Service, Region 1 Forest Health Protection, Missoula, MT 3pp

Goheen, D.J., and E.M. Hansen. 1993. *Effects of Pathogens and Bark Beetles on Forests*. Pages 175 through 196 in Beetle-Pathogen Interaction in Conifer Forests. Schowalter, T.D., and G.M. Filip, eds. Academic Press, San Diego, CA 252pp

Graham, R.T., A.E. Harvey, M.F. Jurgensen, T.B. Jain, J.R. Tonn, and D.S. Page-Dumroese. 1994. *Managing Coarse Woody Debris in Forests of the Rocky Mountains*. USDA Forest Service Research Paper. INT-RP-477. 13pp

Green, P., J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann. 1992. *Old-growth Forest Types of the Northern Region*. R-1 SES. USDA Forest Service, Northern Region, Missoula, MT 60pp

Groom, M, D.B. Jensen, R.L. Knight, S. Gatewood, L. mills, D. Boyd-Heger, L.S. Mills, and M.E. Soule. *Buffer Zones: Benefits and Dangers of Compatible Stewardship*. Pages 171-197 *in* Soule, M. and J. Terborgh, eds. 1999. Continental Conservation: Scientific Foundation of Regional Reserve Networks. Island Press, Washington DC

Griffith, J.S. 1988. *Review of Competition Between Cutthroat Trout and Other Salmonids*. American Fisheries Society Symposium 4:134-140

Hadfield, J.S., D.J. Goheen, G.M. Filip, C.L. Schmitt, and R.D. Harvey. 1986. *Root Diseases in Oregon and Washington Conifers*. USDA Forest Service. Report R6-FP-250-86

Hansen, E.M., and K.J. Lewis, editors. 1997. Compendium of Conifer Diseases. APS Press, St. Paul, MN 101p

Hansen, P., R. Pfister, K. Boggs, B. Cook, J. Joy, D. Hinckley. 1995. *Classification and Management of Montana's Riparian and Wetland Sites*. Miscellaneous Publication No. 54. University of Montana, Montana Forest and Conservation Experiment Station, Missoula, MT

Harlow, W.M., E.S. Harrar, and F.M. White. 1979. Textbook of Dendrology: Covering the Important Forest Trees of the United States and Canada. Sixth Edition. pp 146-153

Harrelson, C.C., C.L. Rawlins, J.P. Potyondy. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique*. General Technical Report RM-245. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO

Harris, R. 1999. *Abundance and Characteristics of Snags in Western Montana Forests*. General Technical Report RMRS-GTR-31. Rocky Mountain Research Station, Missoula, MT 19pp

Hart, M. 1989. *Past and present Vegetative and Wildlife Diversity in Relation to an Existing Reserve Network: A GIS Evaluation of the Seeley-Swan Landscape, Northwest Montana*. Master thesis. University of Montana, Missoula, MT 288pp

Haupt, H.F., et al. 1974. *Forest Hydrology Part II Hydrologic Effects of Vegetation Manipulation*. USDA Forest Service, Region 1. Missoula, MT

Heinemeyer, K., and J. Jones. 1994. Fisher Biology and Management in the Western United States: A Literature Review and Adaptive Management Strategy. USDA Forest Service, Northern Region, Missoula, MT 108pp

Johnson, S. 1984. *Home Range, Movements, and Habitat Use of Fishers in Wisconsin*. M.S. Thesis, University of Wisconsin, Stevens Point, WI 78pp

Jones, J.L. 1991. *Habitat Use of Fisher in Northcentral Idaho*. M.S. Thesis, University of Idaho, Moscow, ID 147pp

Jones, J.L., and E.O. Garton. 1994. *Selection of Successional Stages by Fishers in Northcentral Idaho*. Pages 377-387 *in* Buskirk, S.W., A.S. Harestad, M.G. Raphael, and R.A. Powell, eds. Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press, NY

Kanda, N., R.F. Leary, and F.W. Allendorf. 1997. *Population Genetic Structure of Bull Trout in the Upper Flathead River Drainage*. Friends of the Bull Trout Conference Proceedings, May 5-7, 1994, 299-308

Keegan, Charles et al, 1995, Montana’s Forest Products Industry, A Descriptive Analysis, 1969-1994

Kelsey, R.G., and G. Joseph. 1998. *Ethanol in Douglas-fir with Black-stain Root Disease (Leptographium wageneri).* Canadian Journal of Plant Pathology 18:194-199

Koehler, G.M. 1990. *Population and Habitat Characteristics of Lynx and Snowshoe Hares in North Central Washington*. Canadian Journal of Zoology 68:845-851

Kohler, S. 2003. Montana Department of Natural Resources and Conservation. Personal communication

Kolbe, J.A., J.R. Squires, D.H. Pletscher, and L. F. Ruggiero. In Press. *The Effect of Snowmobile Trails on the Coyote Movements within Lynx Home Ranges.* Journal of Wildland Management 72:1444-1451

Koopal, M. 2002a. South Fork Lost Creek R1/R4 Fish Habitat Inventory. Unpublished report prepared for Montana Department of Natural Resources and Conservation, Kalispell, MT

Koopal, M. 2002b. Soup Creek R1/R4 Fish Habitat Inventory. Unpublished report prepared for Montana Department of Natural Resources and Conservation, Kalispell, MT

Koopal, M. 2004. Upper Soup Creek R1/R4 Fish Habitat Inventory. Unpublished report prepared for Montana Department of Natural Resources and Conservation, Missoula, MT

Koplin, J.R. 1972. Measuring Predator Impact of Woodpeckers on Spruce Beetles. Journal of Wildland Management 36:308-320

Kunkel, K., T.K. Ruth, D.H. Pletscher, and M.G. Hornocker. 1999. *Winter Prey Selection by Wolves and Cougars In and Near Glacier National Park, Montana*. Journal of Wildland Management 63:901-910

Leaf, Charles F. 1975. *Watershed Management in the Rocky Mountain Subalpine Zone: The Status of Our Knowledge.* Research Paper RM137. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Ft. Collins, CO

Leathe, S.A, S. Bartelt, L.M. Morris. 1985. *Cumulative Effects of Micro-Hydro Development on the Fisheries of the Swan River Drainage, Montana*. Vol. III: Fish and Habitat Inventory of Tributary Streams. Bonneville Power Administration, Division of Fish and Wildlife. Project 82-19

Lesica, Peter. 1996. *Using Fire History Models to Estimate Proportions of Old Growth Forest in Northwest Montana, USA*. Conservation Biological Research, University of Montana, Missoula, Montana. Biological Conservation 77:33-39

Liknes, G.A. and P.J. Graham. 1988. *Westslope Cutthroat Trout in Montana: Life History, Status, and Management*. American Fisheries Society Symposium 4:53–60

Livingston, R.L. 1999. *Douglas-fir Beetle in Idaho*. State Forester Forum No. 18. Idaho Department of Lands, Coeur d'Alene, ID 4pp

Losensky, J. 1997. *Historical Vegetation of Montana*. Contract #970900. Montana DNRC. Missoula, MT 109pp

Mace, R.D., and J.S. Waller. 1997. *Final Report: Grizzly Bear Ecology in the Swan Mountains, Montana*. Montana Fish, Wildlife and Parks, Helena, MT 191pp

Mace, R.D., J.S. Waller, T.L. Manley, L.J. Lyon, and H. Zuuring. 1997. *Relationships Among Grizzly Bears, Roads, and Habitat in the Swan Mountains, Montana*. Pages 64-80 *in* Mace, R.D., and J.S. Waller. 1997. Final Report: Grizzly Bear Ecology in the Swan Mountains, Montana. Montana Fish, Wildlife and Parks, Helena, MT 191pp

Maloy, C. 1991. *Review of Echinodontium tinctorium 1895-1990*. Extension Bulletin 1592. Washington State University Cooperative Extension, Pullman. 29pp

Mathiasen, R.L. 1998. *Infection of Young Western Larch by Larch Dwarf Mistletoe in Northern Idaho and Western Montana*. Western Journal of Applied Forestry 13:41-46

MBTRT (Montana Bull Trout Restoration Team). 2000. *Restoration Plan for Bull Trout in the Clark Fork River Basin and the Kootenai River Basin, Montana*. Report prepared for Governor Marc Racicot. Montana Fish, Wildlife and Parks, Helena, MT

MBTSG (Montana Bull Trout Scientific Group). 1996. *Swan River Drainage Bull Trout Status Report (including Swan Lake.)* Report prepared for the Montana Bull Trout Restoration Team. Montana Fish, Wildlife and Parks, Helena, MT

MBTSG (Montana Bull Trout Scientific Group). 1998. *The Relationship Between Land Management Activities and Habitat Requirements of Bull Trout*. Report prepared for the Montana Bull Trout Restoration Team. Montana Fish, Wildlife and Parks, Helena, MT

McClelland, B.R. 1979. *The Pileated Woodpecker in Forests of the Northern Rocky Mountains*. Pages 283-299 *in* Role of Insectivorous Birds in Forest Ecosystems. Academic Press

McNeil, W.J., and W.H. Ahnell. 1964. *Success of Pink Salmon Spawning Relative to Size of Spawning Bed Materials*. U.S. Fish and Wildlife Service. Special Scientific Report: Fisheries No. 469

Mech, L.D. 1987. The Wolf: The Ecology and Behavior of an Endangered Species. University of Minnesota Press, Minneapolis, MN 384pp

MFISH (Montana Fisheries Information System). 2005. Montana Fish, Wildlife and Parks, Montana Natural Resource Information System

MNHP (Montana Natural Heritage Program). 2004. *Animal Species of Concern*. Montana Natural Resource Information System

Montana Department of Environmental Quality. "1996 TMDL Query System." 12 December, 2005. <http://nris.state.mt.us/wis/tmdlapp/tmdl96.asp>

Montana Department of Environmental Quality. "2004 TMDL Query System." 12 December, 2005.<http://nris.state.mt.us/wis/environet/2004Home.html>

Montana Department of Environmental Quality. 2005. "Water Quality Protection Plan and TMDLs for the Swan Lake Watershed" 15 December, 2005 <http://www.deq.mt.gov/wqinfo/TMDL/SwanLake/Final01SwanMasterDoc.pdf>

Montgomery, D.R., and J.M. Buffington. 1997. Channel-*Reach Morphology in Mountain Drainage Basins*. GSA Bulletin. 109(5):596-611

Morrison, D.J., K.W. Pellow, D.J. Norris, and A.F.L. Nemec. 2000. *Visible Versus Actual Incidence of Armillaria Root Disease in Juvenile Coniferous Stands in the Southern Interior of British Columbia*. Canadian Journal of Forest Restoration 30:405-414

Morrison, D., and K. Mallett. 1996. *Silvicultural Management of Armillaria Root Disease in Western Canadian Forests*. Canadian Journal of Plant Pathology 18:194-199

Morrison, D., H. Merler, and D. Norris. 1991. *Detection, Recognition, and Management of Armillaria and Phellinus Root Diseases in the Southern Interior of British Columbia*. Forestry Canada and the British Columbia Ministry of Forests, Victoria, British Columbia, Canada. FRDA Report 179

Morrison, D., and K. Pellow. 1994. *Development of Armillaria Root Disease in a 25-Year-Old Douglas-fir Plantation* in Proceedings of the Eighth International Conference on Root and Butt Rots. IUFRO Working Party S2.06.01. Johansson, M., and J. Stenlid, eds. Swedish University of Agricultural Sciences, Uppsala, Sweden

Morrison, D.J., K.W. Pellow, D.J. Norris, and A.F.L. Nemec. 2000. *Visible Versus Actual Incidence of Armillaria Root Disease in Juvenile Coniferous Stands in the Southern Interior of British Columbia*. Canadian Journal of Forest Research 30:405-414.

Morrison, D.J., K.W. Pellow, A.F.L. Nemec, D.J. Norris, and P. Semenoff. 2001. *Effects of Selective Cutting on the Epidemiology of Armillaria Root Disease in the Southern Interior of British Columbia*. Canadian Journal of Forest Research 31:59-70

Morrison, D.J., R.E. Williams, and R.D. Whitney. 1991. *Infection, Disease Development, Diagnosis, and Detection*. Pages 62 through 75 in Armillaria Root Disease. Shaw, C.G., III, and G.A. Kile, eds. USDA Forest Service. Agriculture Handbook 691

Mowat, G., K.G. Poole, and M. O'Donoghue. 2000. *Ecology of Lynx in Northern Canada and Alaska*. Chapter 9 in Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, et al., tech eds. Ecology and Conservation of Lynx in the United States. University Press of Colorado. Boulder, CO 480pp

Murray, D.L., S. Boutin, and M. O'Donoghue. 1994. *Winter Habitat Selection by Lynx and Coyotes in Relations to Snowshoe Hare Abundance. Canada Journal of Zoology 72:1444-1451*

Nakano, S., K. Fausch, T. Furukawa-Tanaka, K. Maekawa, and H. Kawanabe. 1992. *Resource Utilization by Bull Trout and Cutthroat Trout in a Mountain Stream in Montana, U.S.A*. Japanese Journal of Ichthyology. 39 (3):211-217

NRIS (Natural Resource Information System). 2004. Westslope Cutthroat Trout Distribution, Swan Drainage, HUC Num: 17010211 (map). Montana State Library, Helena, MT

Otvos, I.S. 1965. *Studies on Avian Predators of Dendroctonus brevicomis Leconte (Coleoptera: Scolytidea), with Special Reference to Picidae*. Canadian Journal of Entomology 97:1184-1199

Otvos, I.S. 1979. *The Effects of Insectivorous Bird Activities in Forest Ecosystems: An Evaluation*. Pages 341-374 *in* Dickson, J.G., R.N. Conner, R.R. Fleet, J.C. Kroll, and J.A. Jackson, eds. 1979. The Role of Insectivorous Birds in Forest Ecosystems. Academic Press, New York, NY

Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. General Technical Report INT-GTR-346. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT

Pfankuch, D. J. 1975. *Stream Reach Inventory and Channel Stability Evaluation*. USDA Forest Service, $1-75-002. Government Printing Office #696-260/200, Washington DC 26 pp

Pfister, R.D., B.L. Kovalchik, S.F. Arno, and R.C. Presby. 1977. Forest Habitat Types of Montana. USDA Forest Service General Technical Report. INT-34 Intermountain For. and Range Experiment Station. Ogden, UT 174pp

Pierce, John, and Drake Barton. *Sensitive Plant Survey in the Swan River State Forest, Montana*. Unpublished report to DNRC. December 2003

Pierce, W.R. 1960. *Dwarf Mistletoe and Its Effect Upon the Larch and Douglas-fir of Western Montana*. Bulletin No. 10. Montana State University School of Forestry, Missoula, MT 38pp

Powell, R. 1982. The Fisher: National History, Ecology, and Behavior. University of Minnesota Press, Minneapolis, MN 217pp

Powell, R. and W.J. Zielinski. 1994. *Fisher*. Pages 38-73 *in* Ruggiero, LF, KB Aubry, SW Buskirk, LJ Lyon, WJ Zielinski, eds. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States. US Forest Service General Technical Report RM-254. 184pp

Pratt, K. 1984. *Habitat Use and Species Interactions of Juvenile Cutthroat (Salmo clarki lewisi) and Bull Trout (Salvelinus confluentus) in the Upper Flathead River Basin*. Master's Thesis, University of Idaho, Moscow, ID

Quigley, T.M., and S.J. Arbelbide, tech eds. 1997. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins*. General Technical Report PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 4 vol

Ream, R.R., D.H. Pletscher, M.W. Fairchild, and D.K. Boyd. 1988. *Population and Movements of Recolonizing Wolves in the Glacier National Park Area: Annual report: 1 July 1987 – 30 September 1988*. University of Montana, Missoula, MT 24pp

Redfern, D.B., and G.M. Filip. 1991. *Innoculum and Infection*. Pages 48 through 61 in Armillaria Root Disease. Shaw, C.G., III, and G.A. Kile, eds. USDA Forest Service. Agriculture Handbook 691

Rieman, B.E., and G.L. Chandler. 1999. *Empirical Evaluation of Temperature Effects on Bull Trout Distribution in the Northwest*. Final Report to U.S. Environmental Protection Agency, Boise, ID

Rieman, B.E., and D.L. Myers. 1997. *Use of Redd Counts to Detect Trends in Bull Trout (Salvelinus confluentus) Populations*. Conservation Biology 11(4):1015-1018

Rizzo, D.M., R.A. Blanchette, and G. May. 1995. *Distribution of Armillaria ostoyae Genets in a Pinus resinosa-Pinus banksiana Forest*. Canadian Journal of Botany 73:776 through 787

Robinson, E.G., and R.L. Beschta. 1990. *Identifying Trees in Riparian Areas That Can Provide Coarse Woody Debris to Streams*. Forest Science 36(3):790-800

Robinson, R.M., and D.J. Morrison. 2001. *Lesion Formation and Host Response to Infection by Armillaria ostoyae in the Roots of Western Larch and Douglas-fir*. Forest Pathology 31:371-385

Rosgen, D. 1996. Applied River Morphology. Printed Media Companies. Minneapolis, MN

Rosgen, David L. 1996. *Applied River Morphology.* Wildland Hydrology, Pagosa Springs, CO

Ross, D.W., K.E. Gibson, and G.E. Daterman. 2001. *Using MCH to Protect Trees and Stands From Douglas-fir Beetle Infestation*. Report FHTET-2001-09. USDA Forest Service Forest Health Technology Enterprise Team, Morgantown, WV 11pp

Roth, L.F., L. Rolph, and S. Cooley. 1980. *Identifying Infected Ponderosa Pine Stumps to Reduce Costs of Controlling Armillaria Root Rot.* Journal of Forestry 78:145-148, 151

Ruediger, B., J. Claar, S.L. Mighton, B. Nanaey, T. Tinaldi, F. Wahl, N. Warren, D. Wenger, A. Williamson, L. Lewis, B. Holt, G. Patton, J. Trick, A. Vandehey, and S. Gniadek. 2000. Canada Lynx Conservation Assessment and Strategy (2nd Edition). USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Missoula, MT 122pp

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, et al. 2000. *The Scientific Basis for Lynx Conservation: Qualified Insights*. Chapter 16 in Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, et al (Tech. Eds). 2000. Ecology and Conservation of Lynx in the United States. University Press of Colorado, Boulder, CO 480pp

Schmitz, R.F., and K.E. Gibson. 1996. *Douglas-fir Beetle*. Forest Insect and Disease Leaflet 5. USDA Forest Service, Washington, DC 8pp

Schroeder, L.M., and A. Lindelow. 1989. *Attraction of Scolytids and Associated Beetles by Different Absolute Amounts and Proportions of Alpha-pinene and Ethanol*. Journal of Chemical Ecology 15:807-817

Schwandt, J., and Zack, A. 1996. *White Pine Leave Tree Guidelines*. Report 96-3. USDA Forest Service, Northern Region, Missoula, MT 7pp

Sime, Carolyn A., V. Asher, L. Bradley, K. Laudon, M. Ross, J. Trapp, and L. Handegard. 2006. *Montana Gray Wolf Conservation and Management in the Northern Rockies Wolf Recovery Area*. Pages 3-63 *in* U.S. Fish and Wildlife Service et al. Rocky Mountain Wolf Recovery 2005 Interagency Annual Report. C.A. Sime and E. E. Bangs, eds. USFWS, Ecological Services, 585 Shepard Way, Helena, MT 59601. 130pp

Shepard, B.B., K.L. Pratt, P.J. Graham. 1984. Life Histories of Westslope Cutthroat and Bull Trout in the Upper Flathead River Basin, Montana. Montana Fish, Wildlife and Parks, Kalispell, MT

Sirucek, D.A., and V.C. Bachurski. 1995. *Riparian Landtype Survey of the Flathead National Forest Area, Montana*. U.S. Department of Agriculture, Forest Service, Kalispell, MT

Stanford, J.A., and J.V. Ward. 1993. *An Ecosystem Perspective of Alluvial Rivers: Connectivity and the Hyporheic Corridor*. Journal of the North American Benthological Society 12:48-62

Steeger, C., M.M. Machmer, and B.Gowans. 1998. *Impact of Insectivorous Birds on Bark Beetles: A Literature Review*. Pandion Ecological Research Limited. Ymir, BC

Streamside Management Rules. 1996. Montana Code Annotated 36.11.311 – 36.11.312

SVGBCA. 1997. *Swan Valley Grizzly Bear Conservation Agreement*. USFWS, Helena, MT 37pp

SVGBCA Monitoring Team. 2004. *Swan Valley Conservation Agreement Monitoring Report, Year 2004*. USDI FWS. Helena, MT 7pp.

SVGBCA. 1998. *The Swan Valley Grizzly Bear Conservation Agreement*. USDI Fish and Wildlife Service. Helena, MT 20pp

Sylte, T., and C. Fishenich. 2002. *Techniques for Measuring Substrate Embeddedness*. EMRRP Technical Note: ERDC TN-EMRRP-SR-36, U.S. Army Engineer Research and Development Center, Vicksburg, MS

Thomas, J., K. Sutherland, B. Kuntz, and S. Potts. 1990. Montana Nonpoint Source Management Plan. Montana Department of Health and Environmental Sciences, Water Quality Bureau, Helena, MT

Thomas, J.W. 1979. *Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington*. US Forest Service Agriculture Handbook 553. 512pp

Todd, A.W., L.B. Keith, and C.A. Fisher. 1981. *Population Ecology of Coyotes During a Fluctuation of Snowshoe Hares*. Journal of Wildland Management 47:394:404

Torgersen, T. 1994. *Natural Enemies in Forest Insect Regulation*. Pages 108-111 in Pilarski, M (ed). Restoration Forestry: An International Guide to Sustainable Forestry Practices. Kivaki Press

Troendle, Charles A. 1987. *The Potential Effect of Partial Cutting and Thinning Streamflow from the Subalpine Forest.* Rocky Mountain Forest and Range Experiment Station

USDA Forest Service. Flathead National Forest Plan, Amendment 21, DEIS, Management Direction Related to Old Growth Forests. Kalispell, MT 85pp

USDA Forest Service. 1998. *Soil Survey of the Flathead National Forest Area, Montana.* USDA Forest Service and Natural Resources Conservation Service

USDA Forest Service. 1999. *Douglas-fir Beetle in the Intermountain West*. USDA Forest Service pamphlet.

USDA Forest Service. 2006. Schedule of Proposed Action 71/2006 to 9/30/2006, Flathead National Forest. http://www.fs.fed.us.sopa/forest—level.php?110110

USFWS. 1987. Northern Rocky Mountain Wolf Recovery Plan. USFWS, Denver, CO 119pp

USFWS. 1986. *Recovery Plan for the Pacific Bald Eagle*. USFWS. Portland, OR 160pp

USFWS. 1993. *Grizzly Bear Recovery Plan*. Missoula, MT 181pp

USFWS. 1999. *Rocky Mountain Wolf Recovery: 1999 Annual Report*. USFWS. Helena, MT 22pp

USFWS. 2005. *Recovery Outline: Contiguous United States Distinct Population Segment of the Canada Lynx.* USFWS Mountain-Prairie Region http://mountainprairie.fws.gov/species/mammals/lynx/final%20lynx%20RecoveryOutline9-05.pdf

USFWS, Nez Perce Tribe, National Park Service, Montana Fish, Wildlife and Parks, Idaho Fish and Game, and USDA Wildlife Services. 2006. *Rocky Mountain Wolf Recovery 2005 Annual Report*. Sime, C.A., and E. E. Bangs, eds. USFWS, Ecological Services, 585 Shepard Way, Helena, MT 59601 130pp

Warren, N. 1998. *Old-growth Associated Wildlife: Status and Management Recommendations*. Flathead National Forest, Land Management Technical Note No. 16. 9pp

Weaver, T. 2005. Montana Department of Fish, Wildlife and Parks, Kalispell, MT. Personal communication

Weaver, T., and J. Fraley. 1991. *Fisheries Habitat and Fish Populations*. Flathead Basin Commission, Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program, Kalispell, MT

Welty, J., T. Beechie, K. Sullivan, D. Hyink, R. Bilby, C. Andrus, G. Pess. 2002. *Riparian Aquatic Interaction Simulator (RAIS): A Model of Riparian Forest Dynamics for the Generation of Large Woody Debris and Shade*. Forest Ecology and Management 162:299-318

Wolman, M.G. 1954. *A Method of Sampling Coarse River-Bed Material*. Transaction American Geophysical Union 35(6):951-956

Young, Stephen L. 1989. *Cumulative Watershed Effects*. Lassen National Forest

ACRONYMS

ARM	Administrative Rules of Montana
BMP	Best Management Practices
CEA	Checklist Environmental Assessment
dbh	diameter at breast height
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DFWP	Montana Department of Fish, Wildlife, and Parks
DNRC	Department of Natural Resources and Conservation
ECA	Equivalent Clearcut Acres
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FBC	Flathead Basin Commission
FEIS	Final Environmental Impact Statement
FI	Forest Improvement
FM	Forest Management
FNF	Flathead National Forest
FY	Fiscal Year (July 1 – June 30)
FOGI	Full Old-Growth Index
GIS	Geographic Information System
ID Team	Interdisciplinary Team
MBTRT	Montana Bull Trout Restoration Team
MBTSG	Montana Bull Trout Scientific Group
MCA	Montana Codes Annotated
MEPA	Montana Environmental Protection Act
MFISH	Montana Fisheries Information System
MMBF	Million Board Feet
MNHP	Montana Natural Heritage Program
NRIS	Natural Resource Information System
NWLO	Northwestern Land Office
RMZ	Riparian Management Zone
Rules	Administrative Rules for Forest Management
SFLMP	State Forest Land Management Plan
SLI	Stand-level Inventory
SMZ	Streamside Management Zone
SVGBCA	Swan Valley Grizzly Bear Conservation Agreement
TMDL	Total Maximum Daily Load
USDA	United State Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

124 Permit	Stream Preservation Act Permit
3A Authorization	A short-term Exemption from Montana’s Surface Water Quality and Fisheries Cooperative Program
Land Board	Board of Land Commissioners

Copies of this document with its appendices were published at an approximate cost of $12.72 per copy for printing and $5.00 for mailing.

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
SWAN UNIT OFFICE - SWAN RIVER STATE FOREST
34925 MT HIGHWAY 83
SWAN LAKE, MT 59911
(406) 754-2301 or Fax
(406) 754-2884

Persons with disabilities who need an alternative, accessible
Format of this document should contact DNRC
At the address or phone number shown above.